BC

Ministry of Environment

MOUNT TIMOTHY

SUCCESSION STUDY

MOE Technical Report 12

ISSN 0821-0942

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Ministry of Environment

MOE Technical Report 12

MOUNT TIMOTHY SUCCESSION STUDY

C. E. Thompson

SURVEYS AND RESOURCE MAPPING BRANCH

Kelowna, B.C.

October 1984

Canadian Cataloguing in Publication Data
Thompson, C. E. (Carol Elizabeth), 1949-
Mount Timothy succession study

(MOE technical report, ISSN 0821-0942 ; 12)

Includes bibliographical references.
ISBN 0-7718-8450-8

1. Botany - British Columbia - Timothy, Mount.
2. Cut-over lands - British Columbia - Timothy, Mount. 3. Soils - British Columbia - Timothy, Mount. I. British Columbia. Ministry of Environment. II. Title. III. Series.

QK203.B7T56 1984 581.97112 C84-092278-7

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First Printing 1984.

ACKNOWLEDGEMENTS

I would like to thank the project coordinator, J. van Barneveld for his participation in the project and Phil Epp for his soil's expertise and continual support. Also, I wish to express my appreciation to Anna Roberts and Terry McIntosh for their assistance and expertise in the identification of the Family Poaceace and the bryophytes, respectively.

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1. INTRODUCTION

Mount Timothy, an extinct volcano, lies approximately eleven miles northeast of Lac la Hache (Figure 1.1). In the summer of 1970 this mountain was systematically inventoried and the vegetation classified using nodal association analysis (Lambert et al., 1962) by van Barneveld (1971). Two years later a portion of this area was clearcut. This area was chosen for further study.

The objectives of this study were to:

1) re-inventory the vegetation of Mount Timothy nine years after clearcut logging, and to compare the present floristics to the vegetation classification of the prelogged floristics.
2) to characterize the soils of the project area.

The location of Mount Timothy is shown in Figure 1.1 (92P/14 is the National Topographic Series map sheet number).

The project area falls within the eastern portions of the Fraser Plateau physiographic subdivision (Holland, 1976) which is characterized by rolling uplands and rounded hills. The area is underlain by bedrock of the Nicola Group which is comprised dominantly of volcanic rocks with minor sediments. The most common rocks are very fine grained greenstone with associated laminated tuff, limestone and some argillite. Immediately to the northeast is an extensive area of Thuya and Takomkane Batholiths and similar granitic rocks which typically consist of hornblende - biotite quartz diorite and granodiorite with minor hornblende diorite, monzonite, gabbro and hornblendite. The area was overridden by glacial ice moving from northeast to southwest. This left relatively shallow but widespread glacial deposits which obscure most of the bedrock (Campbell and Tipper, 1971). Soils within the general area tend to be Podzolic Gray Luvisols, Brunisolic Gray Luvisols or Orthic Dystric Brunisols depending upon elevation and type of parent material (Valentine and Schori, 1980).

Figure 1.1 Location of project area.

The vegetation lies in the Engelmann spruce - subalpine fir (wet) subzone of the Engelmann spruce - subalpine fir biogeoclimatic zone at higher elevations and the Interior Douglas-fir - pine grass, northern phase subzone of the Interior Douglas-fir biogeoclimatic zone at lower elevations (Annas and Coupe, 1979).

Climatically, Mount Timothy is located in the Interior Plateau of British Columbia (Schaefer, 1978). The climate of the area is regionally influenced by the Coast Mountains and locally by latitude, elevation and aspect. Due to the position of the region on the leeward side of the Coast Mountains the overall effect of the orographic process is to create a rain shadow.

2. METHOD

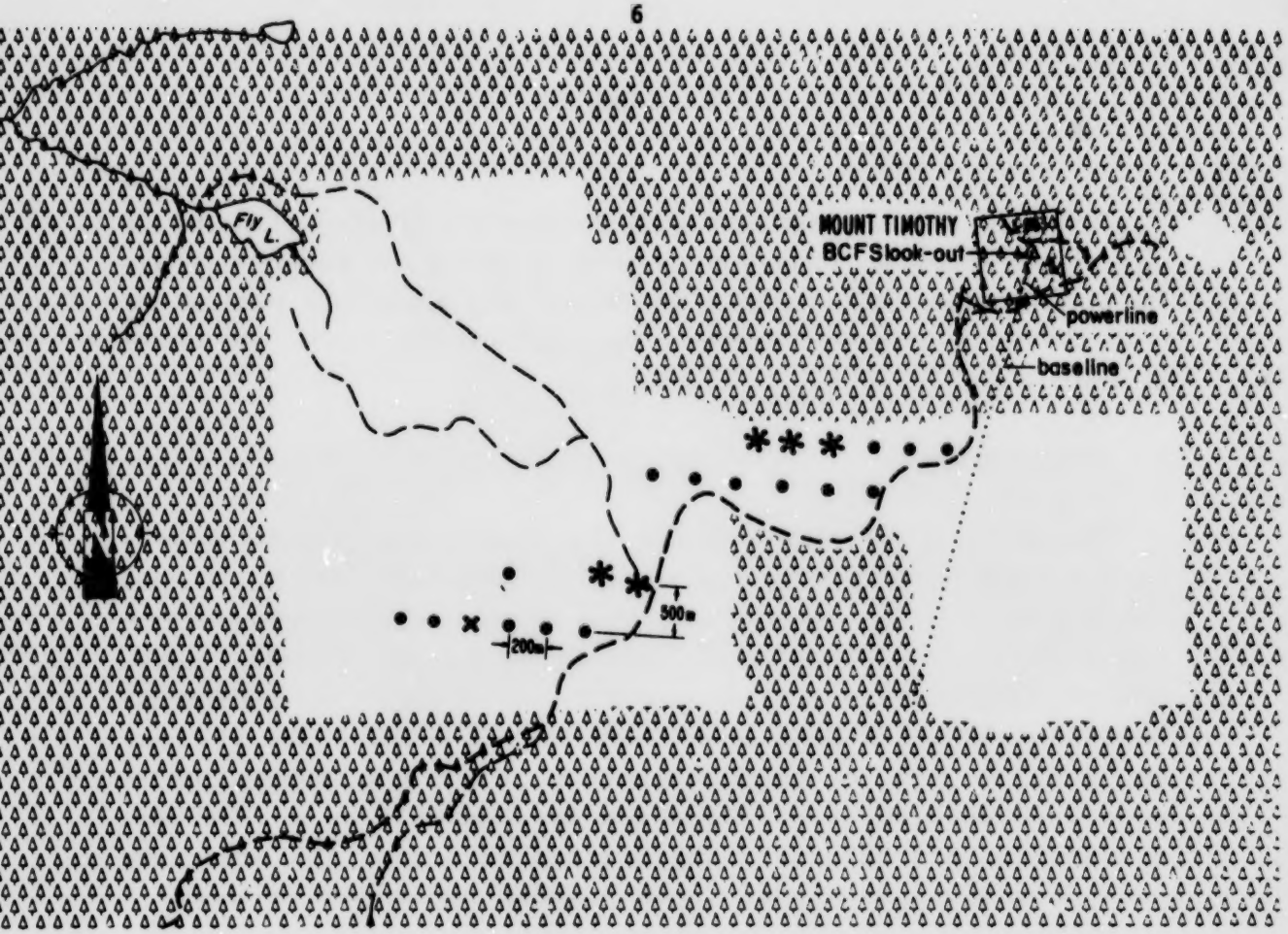
The design of the project, including location and layout of plots and the type of data collected, follows the original project by van Barneveld (1971). The plot locations (referred to as gridpoints) only approximate those of the original (1971) gridpoints, because the previous plots were not marked permanently.

2.1 PROJECT DESIGN

The design of the project is basically a grid network consisting of a baseline, with twelve gridlines and seventy-one gridpoints. The baseline was formed by utilizing the powerline which runs in a southwesterly direction from the British Columbia Forest Service look-out at the apex of Mount Timothy. From this baseline twelve gridlines were projected. A compass bearing from the look-out to Fly Lake of eighty seven degrees is the direction of the gridlines. The rest of the gridlines were located parallel to this line starting from the baseline (Figure 2.1). In the logged area the location of the gridlines were re-established with orange metal stakes because the original line markers had been removed by logging activities. The remaining gridlines were reflagged.

The gridlines were spaced five hundred metres apart along the baseline. Six plots were located on each gridline with the first plot being forty metres in from the baseline in order to eliminate edge effects. Successive gridpoints were spaced two hundred metres apart along the gridline. Each plot diagonally coincided with a section of the gridline.

Only four of the original twelve gridlines (number five to number 8 inclusive) fell within the logged area and therefore were considered in this study.



LEGEND

- Logged area
- Unlogged
- ● Vegetation plot
- ✱ Vegetation, soil and forage plot
- ✖ Vegetation and soil plot

Figure 2.1 Grid layout.

2.2 PLOT LAYOUT

Each gridpoint formed the centre of a .08 hectare square plot. The four corner points and the gridpoint each formed the centre of a .002 hectare circular subplot (Figure 2.2).

2.3 DATA COLLECTION

On each gridpoint plot, site, soil and vegetation data were collected according to Walmsley et al. (1980). Four gridpoints (26, 27, 35, 44) were selected to show the variation in landform and soils. On these plots a complete soil profile was described and classified according to the Canadian System of Soil Classification (CSSC, 1978) by P. Epp. Each horizon was sampled and standard chemical and physical analyses were preformed by the soil laboratory, Ministry of Environment, Kelowna, British Columbia. This data - soil profile descriptions and physical and chemical analysis - is available from the B. C. Soil Information System, British Columbia Ministry of Environment, Victoria.

The vegetation data collected consisted of a list of plant species by horizon. Then, each species was rated for canopy cover, distribution, phenology and vigour. In addition, species frequency was calculated in the .002 ha/circular subplots. Usually only plants in the low shrub, herb and bryophyte layers were present in the smaller subplots.

Forage samples were also collected on the selected logged plots according to the methods described by Demarchi and Harcombe (1982).

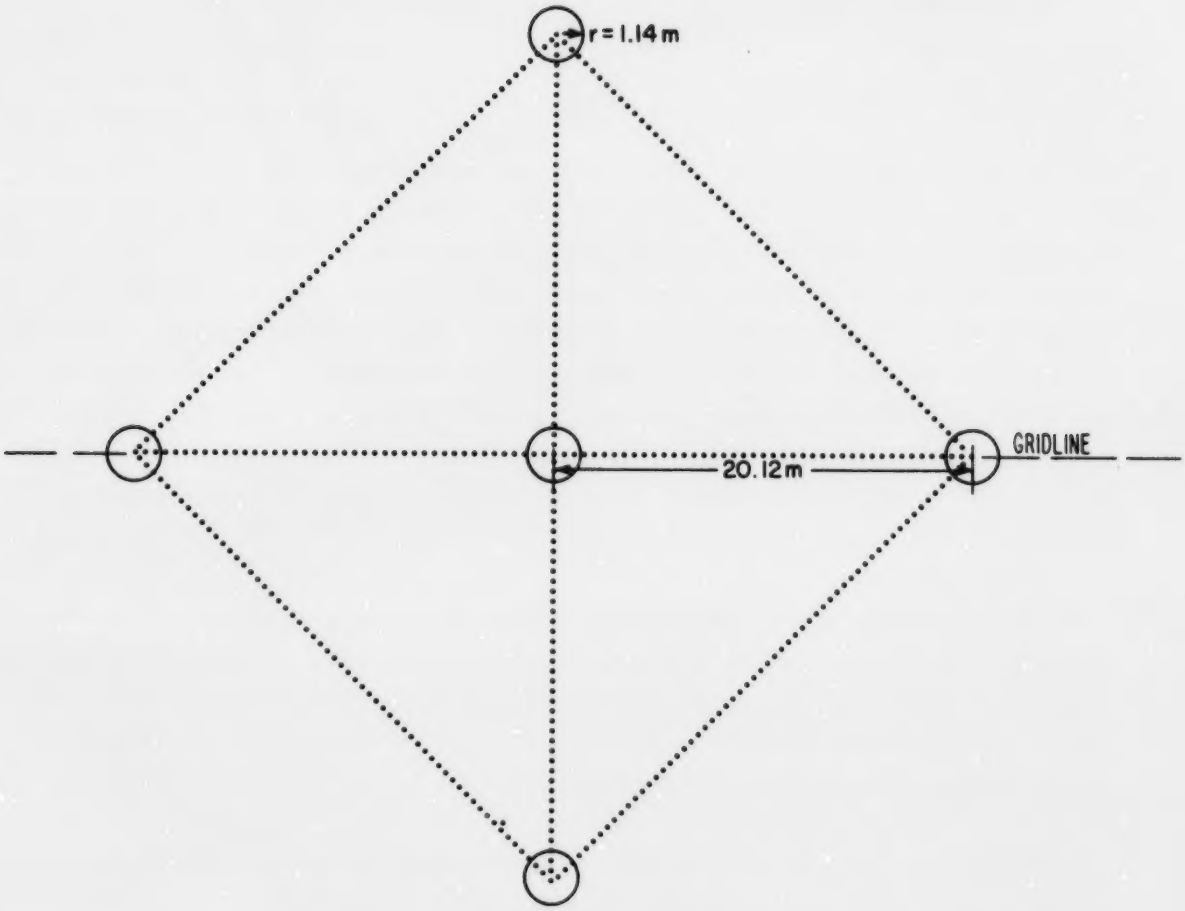


Figure 2.2 Plot layout.

3. RESULTS

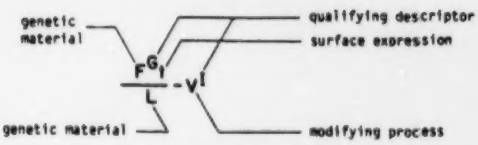
3.1 SOILS[1]

The majority of the soils of the study area are developed on variable depths of morainal materials (Figure 3.1). On lower slopes, the materials are several metres or more thick and show little bedrock influence compared to the relatively shallow deposits on mid and upper slopes. The morainal materials are derived from the underlying volcanic bedrock, as well as, the intrusive (granitic) bedrock to the northeast from where the overriding ice came. Consequently, they tend to be medium to strongly acid and gravelly medium, to gravelly moderately coarse, in texture. Gravelly, coarse-textured fluvioglacial materials overlie some of the lower slope morainal materials and minor bedrock outcropings with associated shallow colluvial deposits occur on some upper slope positions.

Most of the soils developed on the morainal materials are classified as Brunisolic Gray Luvisols or Podzolic Gray Luvisols. These soils generally have relatively thick (up to 8 cm), slightly decomposed, surface organic matter accumulations (LFH horizons) unless severely disturbed by the logging. These are underlain by a very strongly acid zone of iron and aluminum sesquioxide accumulation (Bm or Bf horizon) that is 10 to 20 cm thick, followed by a leached horizon (Ae) of variable thickness. The characteristic, slowly permeable zone of clay accumulation (Bt horizons) generally begins within 50 cm of the soil surface. Relatively unweathered, medium to strongly acid, slowly permeable, compact parent material occurs within 100 cm of the soil surface. The Bt horizon restricts both water and root penetration. Consequently,the soils generally tend to be moderately well drained and can be quite wet in spring and early summer. Moisture in these soils is also significantly affected by slope position: soils on upper slopes tend to be well drained and somewhat drier

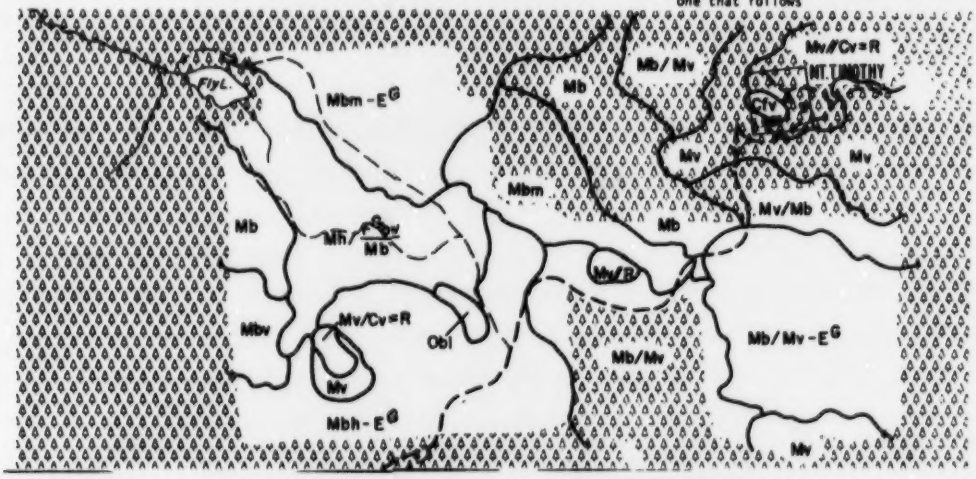
[1] This section was written by P. F. Epp, Pedologist, Soils Unit, Survey and Resource Mapping Branch, Ministry of Environment, Kelowna, British Columbia.

Explanation of Letter Notation



Composite Units

=	the components on either side of this symbol are approximately equal
/	the component in front of the symbol is more extensive than the one that follows
//	the component in front of the symbol is considerably more extensive than the one that follows



Genetic Materials

C	colluvial (A)	Products of mass wastage; generally consists of massive to moderately well stratified, non-sorted to poorly-sorted sediments with a variety of particles sizes and shapes. The coarse fraction of the colluvium in this area varies from predominantly rubbly to blocky sized clasts. Its matrix texture ranges from predominantly silty sand to sandy silt. Includes talus slopes, avalanche cones, mantles of weathered bedrock, and debris from deep and shallow seated failures in both bedrock and unconsolidated material.
F	fluvial (I)	Materials transported and deposited by streams and rivers, alluvial materials; generally consist of gravel, sand, or silt; gravels are typically well-rounded and contain interstitial sand; sediments tend to be moderately to well-sorted and stratified; includes floodplains, river terraces, and some alluvial fans.
M	morainal (I)	Material deposited directly by glaciers, till; generally consists of well-compacted material that is non-stratified and contains a heterogeneous mixture of particle sizes, shapes, and lithologies in a matrix of sand, silt and clay. The coarse particle fraction of the till in this area varies from gravelly to rubbly particle size. Its matrix texture ranges from predominantly sandy silt to silty sand. Deposits include mantles of basal till, some ablation till, and aprons of recent till deposition from ice.
O	organic (A)	Material resulting from the accumulation and decay of vegetative matter; generally consists of peat, although minor amounts of marl and inorganic detritus may be included; includes bogs and fens.
R	bedrock (I)	Outcrops and rock covered by less than 10 cm of unconsolidated material.

Surface Expression

b	blanket	A mantle of unconsolidated material which derives its general surface expression from the topography of the unit which it overlies; it masks minor topographic irregularities in the underlying unit and is more than 1 m thick; if the underlying unit consists of unconsolidated materials, it is shown in the unit symbol; if no underlying unit is shown, it may be assumed to be bedrock.
f	fan	A surface that is a sector of a cone.
h	hummocky	Steep-sided hillocks and hollows that are rounded or irregular in plan; slopes to 10 to 35° predominate on unconsolidated materials and slopes of 10 to 90° predominate on bedrock; local relief is greater than 1 m.
m	subdued	Irregular and linear features with slopes ranging up to 10° and local relief greater than 1 m.
v	veneer	A mantle of unconsolidated materials which has no constructional form of its own, but derives its surface expression from the topography of the underlying surface, is generally between 10 cm and 1 m in thickness, and outcrops of the underlying unit are common; if the underlying material is unconsolidated, it is included in the unit symbol; if no underlying unit is indicated, it is assumed to be bedrock.

Modifying Processes

-E	channelled (I)	Surfaces crossed by channels formed by running water; includes channels of braided streams, meander scars, and scroll patterns.

Qualifying Descriptor

G	glacial	Used to qualify non-glacial genetic materials or process modifiers where there is evidence that glacier ice affected the mode of deposition of materials or the mode of operation of a process.

Figure 3.1 Landforms from the selected and surrounding areas on Mount Timothy.

while soils on lower slope, moisture receiving positions are often imperfectly drained and are classified as Gleyed subgroups of the above soils. The medium to moderately coarse textures result in moderate available water storage capacities. Cation exchange capacities range from about 10 to 20 meq/100 grams. Base saturation often exceeds 50%, particularly in the Bt horizons, but nitrogen and organic matter contents are relatively low.

The soils developed on fluvioglacial over morainal materials are mostly classified as Humo-Ferric Podzols and Dystric Brunisols. These soils are coarser in texture than those on morainal materials and lack a Bt horizon. They are rapidly pervious down to the slowly pervious morainal materials which occur at variable depths. They also tend to have lower available water storage capacities and slightly lower cation exchange capacities due to the coarser textures. Despite being rapidly pervious in the upper soil horizons, these soils tend to be imperfectly drained because of their general location in lower slope, moisture receiving positions and the drainage restrictions caused by the underlying morainal materials.

The soils developed on colluvial materials tend to be dominantly Brunisolic Gray Luvisols due to having developed on colluvium with a significant proportion of incorporated morainal material. They have the general charcteristics of the soils described above under morainal materials with the exceptions that they are somewhat coarser in texture and contain a higher proportion of coarse fragments. They are also drier due to their location in shedding landscape positions and tend to have thinner LFH horizons.

3.2 VEGETATION

In 1971, van Barneveld utilized the nodal association analysis to classify and describe the vegetation on Mount Timothy. This computer program (nodal association) extracted two major plot groups, which were further divided into community types and then into variants. Since, the clearcut area only partially covered gridline 5 to gridline 8 or gridpoint plot 23 to 45 with the

exception of gridpoint plots 36, 37, 38, 44 and 46 (gridpoint plot 39 and 28 was disregarded from the analysis) which fell within the unlogged sections.

In the following section the present vegetation by plot is compared to the variants as defined by van Barneveld (1971). First, the species composition and general ecology of the community type and variant prior to logging is presented to give the basis for the comparison. Then, by gridpoint, the present community is discussed within a framework of presence or absence of species in comparison to the original variant. The floristic data for the post-logged plots follows each description. For an explanation of the terms and codes used see Appendix A. Frequency, phenology and vigour are listed once per species. The term spruce hybrid refers to a hybrid between white spruce and Engelmann spruce.

The community type and variant names were retained from van Barneveld (1971).

The floristics from the original variants are listed in Appendix C.

The vascular plant names follow Taylor and MacBryde (1977). The moss botanical names conform to Crum et al. (1973), the liverwort botanical names are after Stotler et al. (1977) and the lichen botanical names are after Hale et al. (1970). A cross-reference list to the botanical names is presented in Appendix B.

The two major plot groups delineated generally correspond to two biogeoclimatic zones (Annas and Coupe, 1979) - Engelmann Spruce - Subalpine Fir Zone and Interior Douglas-fir Zone.

3.2.1 Engelmann Spruce - Subalpine Fir Zone

In the Engelmann spruce - Subalpine fir zone four community types were recognized: Cornus-moss, Lonicera-Cornus, Pinus-Lupinus and Abies-shrub (van Barneveld, 1971). Each of these contains two or more variants.

3.2.1.1 Cornus-moss Community Type

Generally, the Cornus-moss Community Type is found on morainal material with variable drainage and textures. Van Barneveld (1971) states: it is characterized by a tree canopy of lodgepole pine with a dense understory of alpine fir or Sitka mountain alder with scattered birch-leaved spirea. The herb layer has a sparse cover composed of sweet-scented bedstraw, large-leaved rattlesnake orchid, mountain sweetcicely and one-sided wintergreen.

It has three variants: Ribes, Tiarella and Alnus.

Cornus-moss: Ribes variant

Before logging, van Barneveld (1971) described the vegetation as follows: in addition to lodgepole pine, occasionally Rocky Mountain Douglas-fir veterans, spruce hybrids and alpine fir are present in the tree canopy. Black swamp gooseberry, western thimbleberry, Sitka mountain-ash, alpine fir seedlings and sometimes common saskatoon and bristly Nootka rose make up the shrub layer. In the herb layer blue-bead clintonia, western fescue, dwarf red blackberry, false Solomon's-seal, western meadow-rue and occasionally, showy aster and northwestern sedge are present. Ptilium crista-castrensis is in the moss layer.

1981 Gridpoint Samples
Gridpoint 31 (Table 3.1)

Following logging, at present the dominant shrub is Sitka mountain alder. The low shrub layer is open and sparse with birch-leaved spirea and American red raspberry dominating. Black swamp gooseberry, western thimbleberry, Sitka mountain-ash, and bristly Nootka rose are still present but, in lesser amounts. Common saskatoon is absent. The character species: sweet-scented bedstraw, large-leaved rattlesnake orchid, mountain sweetcicely and one-sided wintergreen were not present in the herbaceous layer. This layer is rich in species but, no species or group of species is abundant. The moss Ptilium crista-castrensis is not present.

Table 3.1

Floristic Data - Gridpoint no. 31
(% C - Percent Canopy Cover, D - Distribution,
F - Total Frequency, P - Phenology, and V - Vigour)

LAYER	SPECIES	%C	D	F	P	V
B_1	Sitka mountain alder	80	8	100	6/10	2
B_2	lodgepole pine	3	4	20	6/0	2
	alpine fir	2	4	20	6/0	2
	birch-leaved spirea	8	7	100	6/7	2
	twinberry honeysuckle	2	5	0	6/10	2
	black swamp gooseberry	2	5	0	6/10	2
	western thimbleberry	2	5	0	6/0	2
	American red raspberry	10	5	40	6/10	2
	Oregon boxwood	3	5	20	6/0	2
	bristly Nootka rose	3	5	40	6/10	2
	black blueberry	1	5	20	6/0	2
	Sitka mountain-ash	1	5	0	6/0	2
C	common cow-parsnip	2	5	0	6/0	2
	green false hellebore	2	5	0	6/0	2
	fireweed	10	5	80	6/3	2
	white hawkweed	1	4	40	6/9	2
	spike trisetum	3	5	0	6/9	2
	bluejoint small reed grass	3	5	40	6/5	2
	Arctic lupine	2	5	0	6/10	2
	false Solomon's-seal	1	4	60	6/9	2
	star-flowered false Solomon's-seal	1	4	0	6/0	2
	western meadow-rue	1	5	0	6/0	2
	red baneberry	2	5	0	6/10	2
	heart-leaved arnica	1	4	80	6/0	2
	Canadian bunchberry	2	5	80	6/9	2
	yarrow	1	4	0	6/0	2
	sweet-scented bedstraw	1	5	20	6/10	2
	Columbia brome grass	1	5	0	6/7	2
	Columbia lily	1	2	0	6/3	2
	Sitka columbine	1	3	0	6/9	2
	blue-bead clintonia	1	4	0	6/0	2
	common pink pyrola	1	4	20	6/0	2
	spiny shield fern	1	4	0	6/0	2
	blue wild rye grass	1	5	0	6/7	2
	nodding trisetum	1	5	20	6/9	2
	willowherb	1	2	20	6/4	2
	wood reed grass	3	5	0	6/5	2
	aster	3	5	0	6/7	2
	pine grass	5	5	20	6/7	2
	northern twinflower	1	5	0	6/0	2
D	Polytrichum juniperinum	2	5	0		
	Dicranum scpoarium	1	5	0		
	Brachythecium sp.	R	1	0		

Gridpoint 32 (Table 3.2)

Following logging, lodgepole pine and alpine fir are regenerating in the shrub layer. Similar to plot 31, Sitka mountain alder dominates the tall shrub layer. The low sparse shrub layer consists of alpine fir regeneration, Nootka rose, western thimbleberry and black swamp gooseberry. The character species: sweet scented bedstraw, large-leaved rattlesnake orchid, mountain sweetcicely and one-sided wintergreen were not present in the herbaceous layer. This layer is rich in species but, no species or group of species is abundant.

These plots generally occurs on moderately well to imperfectly drained, moderately coarse textured fluvioglacial over morainal material.

Cornus-moss: Tiarella variant

Before logging, van Barneveld (1971) described the vegetation as follows: in addition to the community type characteristics in which lodgepole pine dominates, alpine fir and Douglas-fir were also present in the tree canopy. The shrub layer consisted of Sitka mountain alder, twinberry honeysuckle, black swamp gooseberry, western thimbleberry, Sitka mountain-ash and birch-leaved spirea. Spruce hybrid regeneration was sometimes present. The lush herb layer consisted of red baneberry, asters, blue-bead clintonia, Canadian bunchberry, western fescue, wild strawberry, mountain sweetcicely, evergreen yellow violet, unifoliate-leaved foamflower, one-sided wintergreen, dwarf red blackberry, false Solomon's-seal, simple-stemmed twistedstalk and western meadow-rue. The continuous moss layer was formed by Dicranum fuscescens and Ptilium crista-castrensis.

1981 Gridpoint Sample
Gridpoint 26 (Table 3.3)

Following logging, trembling aspen is the main tree species regenerating in the open shrub layer. Alpine fir and lodgepole pine are sparse and Rocky

Table 3.2

Floristic Data - Gridpoint no. 32
(% C - Percent Canopy Cover, D - Distribution,
F - Total Frequency, P - Phenology, and V - Vigour)

LAYER	SPECIES	%C	D	F	P	V
B_1	alpine fir	3	1	40	6/0	2
	Sitka mountain alder	70	8	60	6/10	2
B_2	willows	4	3	0	6/0	2
	lodgepole pine	2	4	0	6/0	2
	alpine fir	5	4	0	6/0	2
	spruce hybrid	2	4	0	6/0	2
	black swamp gooseberry	2	5	20	6/10	2
	Sitka mountain-ash	2	3	0	6/10	2
	bristly Nootka rose	5	5	20	6/10	2
	black blueberry	2	4	20	6/0	2
	western thimbleberry	8	4	60	6/9	2
	Oregon boxwood	2	5	40	6/0	2
	birch-leaved spirea	1	4	40	6/7	2
	American red raspberry	5	4	20	6/10	2
	twinberry honeysuckle	1	5	20	6/10	2
C	showy aster	5	4	20	6/7	2
	white hawkweed	1	4	40	6/9	2
	false Solomon's-seal	1	4	20	6/9	2
	star-flowered false Solomon's-seal	1	4	20	6/0	2
	fireweed	10	5	80	6/0	2
	Canadian bunchberry	2	4	20	6/0	2
	dwarf red blackberry	1	5	0	6/10	2
	sweet-scented bedstraw	1	4	20	6/0	2
	green pyrola	1	4	0	6/3	2
	bluejoint small reed grass	10	5	20	6/7	2
	spike trisetum	1	5	0	6/9	2
	pine grass	3	5	20	6/7	2
	Columbia lily	R	2	0	6/3	2
	blue-bead clintonia	R	2	0	6/0	2
	heart-leaved arnica	2	4	60	6/0	2
	western meadow-rue	5	5	60	6/0	2
	common pink pyrola	2	5	40	6/0	2
	yarrow	1	4	0	6/0	2
	aster	1	4	40	6/0	2
	wild strawberry	1	4	20	6/0	2
	herb	1	4	0	6/0	2
	five-stamened mitrewort	R	4	0	6/10	2
	clover	1	5	0	6/8	2
	cream-colored peavine	R	4	0	6/0	2
	common pearly everlasting	R	4	20	6/7	2
	sedge	R	4	20	6/7	2
	American vetch	R	4	20	6/0	2
	palmate colt's-foot	R	4	20	6/0	2
	common dandelion	R	4	20	6/0	2
	red baneberry	1	4	20	6/10	2
	common horsetail	1	5	20	6/0	2
	sandwort	1	4	0	6/7	2
	northern twinflower	5	5	40	6/0	2
D	Marchantia polymorpha	1	5	20		

Table 3.3

Floristic Data - Gridpoint no. 26
(% C - Percent Canopy Cover, D - Distribution,
F - Total Frequency, P - Phenology, and V - Vigour)

LAYER	SPECIES	%C	D	F	P	V
B_1	trembling aspen	3	5	40	6/0	2
B_2	lodgepole pine	1	2	20	6/0	2
	alpine fir	4	4	20	6/0	2
	trembling aspen	15	4	40	6/0	2
	twinberry honeysuckle	4	4	60	6/3	2
	Sitka mountain-ash	2	4	0	6/0	2
	Sitka mountain alder	2	4	0	6/10	2
	western thimbleberry	10	4	60	6/0	2
	Oregon boxwood	2	5	0	6/0	2
	black blueberry	1	5	20	6/0	2
	birch-leaved spirea	1	2	0	6/4	2
	black swamp gooseberry	2	3	20	5/0	2
C	red baneberry	1	2	20	6/0	2
	bluejoint small reed grass	8	5	20	6/8	2
	spike trisetum	30	7	60	6/9	2
	wood-rush	1	4	0	6/7	2
	hair bent grass	2	5	0	6/7	2
	western fescue	1	5	40	6/9	2
	blue wild rye grass	2	5	20	6/7	2
	Kentucky blue grass	2	5	0	6/9	2
	fowl blue grass	1	5	0	6/9	2
	bracted lousewort	1	4	20	6/9	2
	fireweed	5	4	100	6/3	2
	star-flowered false Solomon's-seal	1	4	0	6/0	2
	blue-bead clintonia	1	4	40	6/0	2
	palmate colt's-foot	5	4	20	6/0	2
	white hawkweed	1	4	40	6/9	2
	Canadian bunchberry	1	4	60	6/0	2
	Arctic lupine	15	5	80	6/10	2
	aster	5	4	80	6/7	2
	green false hellebore	2	4	0	6/0	2
	dwarf red blackberry	5	4	100	6/10	2
	common dandelion	2	4	0	6/0	2
	racemose pussytoes	1	4	0	6/9	2
	Canada hawkweed	1	4	20	6/7	2
	cucumberroot twisted stalk	1	4	0	6/0	2
	Columbia lily	1	4	20	6/3	2
	sedge	1	4	0	6/7	2
	western meadow-rue	1	4	0	6/0	2
	common cow-parsnip	2	4	20	6/0	2
	arrow-leaved ragwort	1	4	20	6/7	2
	violet	1	4	20	6/0	2
	mitrewort	1	4	20	6/0	2
	wild strawberry	2	5	20	6/10	2
	showy aster	2	5	0	6/0	2
	common horsetail	1	5	20	6/0	2
	yarrow	R	2	0	6/0	2
	chickweed	R	2	0	6/0	2

Mountain Douglas-fir is not present. The low shrub layer is very similar in species to the original plot with western thimbleberry being the dominant shrub. Of the original herb species, red baneberry, asters, Canadian bunchberry, wild strawberry, dwarf red blackberry and western meadow-rue still occur. Several species - spike trisetum, Arctic lupine and bluejoint small reed grass which were not present before are now dominant. The moss layer is patchy and is formed by Dicranum sp.

This gridpoint occurs on imperfectly drained, medium textured deep morainal material. The soil is classified as a Gleyed Ferro-Humic Podzol.

Cornus-moss: Alnus variant

Before logging, van Barneveld (1971) described the vegetation as follows: the mixed tree canopy was dominantely lodgepole pine with occasional occurrence of scattered alpine fir, spruce hybrids and Rocky Mountain Douglas-fir. Sitka mountain alder competed for dominance in tall shrub layer. Sitka mountain-ash, birch-leaved spirea and spruce hybrids were occasionally present in the low shrub layer. Herbs were scarce on the thin but continuous moss layer of Pleurozium schreberi.

1981 Gridpoint Samples
Gridpoint 23 (Table 3.4)

Following logging, the dense tall shrub cover consists of alpine fir and Sitka mountain alder (this is similar to the original variant). In the low shrub layer, birch-leaved spirea, mountain-ash plus, Oregon boxwood and black blueberry are occasionally present. The herb layer is diffuse with commonly occurring species being Arctic lupine, fireweed, Wheeler's blue grass and spike trisetum. The community type character species are absent. No moss layer is present.

Table 3.4

Floristic Data - Gridpoint no. 23
(% C - Percent Canopy Cover, D - Distribution,
F - Total Frequency, P - Phenology, and V - Vigour)

LAYER	SPECIES	%C	D	F	P	V
B_1	alpine fir	40	5	100	6/0	2
	Sitka mountain alder	30	5	40	6/7	2
B_2	alpine fir	30	4			2
	western mountain-ash	15	4	0	6/3	2
	Oregon boxwood	10	5	40	6/0	2
	birch-leaved spirea	3	4	60	6/3	2
	black swamp gooseberry	2	5	0	6/0	2
	twinberry honeysuckle	2	4	20	6/7	2
	black blueberry	2	5	40	6/0	2
	American red raspberry	5	4	100	6/0	2
C	Columbia lily	1	4	0	6/7	2
	sickle-top lousewort	2	5	0	6/7	2
	Arctic lupine	5	5	20	6/7	2
	wild strawberry	4	5	40	6/0	2
	fireweed	12	4	100	6/0	2
	white hawkweed	2	4	80	6/7	2
	western fescue	2	5	20	6/4	2
	wheeler's blue grass	10	5	20	6/4	2
	common dandelion	2	4	40	6/0	2
	spike trisetum	7	5	20	6/4	2
	asters	1	4	0	6/7	2
	Canadian bunchberry	1	4	80	6/0	2
	heart-leaved arnica	2	4	80	6/0	2
	sweet-scented bedstraw	1	4	0	6/8	2
	arrow-leaved ragwort	1	4	0	6/7	2
	yarrow	1	4	20	6/0	2
	wood-rush	1	4	0	6/7	2
	western meadow-rue	1	4	40	6/0	2
	little-flowered buttercup	1	4	20	6/7	2
	common cow-parsnip	R	2	0	6/0	2
	blue-bead clintonia	2	4	40	6/0	2
	clover	1	4	0	6/7	2
	northern twinflower	2	5	0	6/0	2
	bluejoint small reed grass	5	5	60	6/4	2
	Sitka columbine	1	4	0	6/4	2
	green pyrola	1	4	40	6/7	2
	sandwort	1	4	0	6/0	2
	blue wild rye grass	1	4	20	6/7	2
	false Solomon's-seal	1	4	0	6/7	2
	red baneberry	1	4	0	6/0	2
	trifoliate-leaved foamflower	R	2	0	6/0	2
	sedges	2	5	40	6/4	2

Gridpoint 27 (Table 3.5)

Following logging, only a low open shrub layer exists with lodgepole pine regeneration. Sitka mountain alder is the dominant shrub. Sitka mountain-ash and spruce hybrids were not present. The herb layer is abundant in species with showy aster, fowl blue grass, Scribner's small reed grass and fireweed being predominant. The community type character species are absent. The prevalent moss Pleurozium schreberi is replaced by Polytrichum juniperinum.

This plot occurs on well drained, moderately coarse textured soils developed on deep morainal material. The soil is classified as a Luvisolic Humo-Ferric Podzol.

3.2.1.2 Lonicera - Cornus Community Type

The honeysuckle-dogwood Community Type is located on poorly or imperfectly drained deep morainal material. van Barneveld (1971) states: it is characterized by the abundance or persistence of false Solomon's-seal under respectively good and poor light conditions.

Two variants are recognized: Equisteum and Pyrola.

Lonicera - Cornus: Equisteum variant

Before logging, van Barneveld (1971) describes the vegetation as follows: alpine fir and spruce hybrids dominated the tree canopy. Minor amounts of remaining seral species, lodgepole pine, Rocky Mountain Douglas-fir and trembling aspen were present too. Sitka mountain alder, black swamp gooseberry and birch-leaved spirea make up the open shrub layer. Also, occasionally spruce regeneration and Sitka mountain-ash were present. Red baneberry, asters, Canadian bunch-berry, marsh horsetail, western fescue, wild strawberry, northern twinflower, five-stamened mitrewort, one-flowered wintergreen, mountain sweetcicely, Arctic colt's-foot, lesser pyrola, one-sided wintergreen,

Table 3.5

Floristic Data - Gridpoint no. 27
(% C - Percent Canopy Cover, D - Distribution,
F - Total Frequency, P - Phenology, and V - Vigour)

LAYER	SPECIES	%C	D	F	P	V
B_2	lodgepole pine	30	7	100	6/0	2
	Sitka mountain alder	10	4	0	6/0	2
	Oregon boxwood	1	4	40	6/0	2
	black blueberry	1	4	0	6/0	2
	western thimbleberry	2	5	20	6/0	2
	black swamp gooseberry	1	3	20	6/0	2
	Scouler's willow	R	2	0	6/0	2
	Drummond's willow	R	2	0	6/0	2
	willow	3	2	40	6/0	2
	bristly Nootka rose	1	5	0	6/0	2
	trembling aspen	R	1	0	6/0	2
	birch-leaved spirea	1	5	20	6/7	2
C	Canadian bunchberry	7	7	80	6/8	2
	showy aster	8	4	100	6/4	2
	heart-leaved arnica	1	4	80	6/8	2
	Arctic lupine	25	5	40	6/8	2
	common dandelion	1	4	60	6/0	2
	white hawkweed	2	4	100	6/7	2
	aster	1	4	60	6/0	2
	yarrow	1	4	60	6/0	2
	fowl blue grass	10	7	0	6/7	2
	Scribner's small reed grass	15	7	0	6/7	2
	spike trisetum	5	5	20	6/7	2
	pine grass	5	5	0	6/7	2
	clover	2	5	0	6/7	2
	western fescue	1	4	0	6/7	2
	false Solomon's-seal	R	2	20	6/7	2
	palmate colt's-foot	1	5	0	6/0	2
	mountain sweetcicely	R	2	0	6/0	2
	western meadow-rue	R	2	0	6/0	2
	northern twinflower	1	5	20	6/8	2
	Scribner's small reed grass	5	5	60	6/7	2
	blue-bead clintonia	2	4	0	6/0	2
	Columbia lily	2	4	20	6/7	2
	fireweed	30	7	100	6/7	2
	sedge	R	2	0	6/7	2
	rosy pussytoes	1	3	0	6/7	2
	common pearly everlasting	1	3	0	6/7	2
	little-flowered buttercup	R	2	0	6/7	2
	wood-rush	1	5	0	6/7	2
	common timothy	1	5	0	6/7	2
D	Polytrichum juniperinum	30	7	100		2
	Ceratodon purpureus	10	7	100		2

dwarf red blackberry, western meadow-rue, unifoliate-leaved foamflower, spike trisetum, evergreen yellow violet and often blue-bead clintonia, oak fern, common cow-parsnip, fringed grass-of-parnassus, little-flowered buttercup, arrow-leaved ragwort, cucumberroot twistedstalk and green false hellebore make up the lush herb layer. Pleurozium schreberi and Mnium glabrescens were the major components of the moss layer.

1981 Gridpoint Samples
Gridpoint 24 (Table 3.6)

Following logging, the shrub layer is open; trembling aspen and Sitka mountain alder make up the tall shrub layer. Alpine fir, spruce hybrids, black swamp gooseberry, birch-leaved spirea are present in minor amounts. The herbaceous layer is rich. The character species, false Solomon's-seal, for the community type is present but several others are absent: five-stamened mitrewort, one-flowered wintergreen, mountain sweetcicely, one-sided wintergreen, marsh horsetail, lesser pyrola and evergreen yellow violet. Since this is a wetter poorly drained site, common cow-parsnip, fringed grass-of-parnassus and green false hellebore are common.

Gridpoint 29 (Table 3.7)

Following logging, minor amounts of the seral species lodgepole pine and trembling aspen are present in addition to spruce hybrids and alpine fir. Black swamp gooseberry is the dominant shrub. Sitka mountain alder, birch-leaved spirea and Sitka mountain-ash are absent. Instead a new species American red raspberry is present. The herbaceous layer is not as diverse as in gridpoint no. 24 due to the dominance of fireweed. The character species false Solomon's-seal is present, but several others are consistently absent including the wetter species found in gridpoint no. 24. The mosses Pleurozium schreberi and Mnium glabrescens found in the original variant have been replaced by Aulacomnium palustre and Leptobryum pyriforme.

This gridpoint occurs on imperfectly drained, moderately coarse textured soils developed on morainal material.

Table 3.6

Floristic Data - Gridpoint no. 24
(% C - Percent Canopy Cover, D - Distribution,
F - Total Frequency, P - Phenology, and V - Vigour)

LAYER	SPECIES	%C	D	F	P	V
B_1	trembling aspen	15	5	40	6/0	2
	Sitka mountain alder	15	4	0	6/10	2
	willow	R	2	0	6/10	2
B_2	alpine fir	5	4	40	6/0	2
	spruce hybrid	3	4	0	6/0	2
	black swamp gooseberry	5	5	100	6/0	2
	twinberry honeysuckle	4	5	40	6/7	2
	western thimbleberry	5	4	60	6/0	2
	birch-leaved spirea	2	4	0	6/7	2
	high bush cranberry	1	4	0	6/0	2
	Oregon boxwood	1	4	0	6/0	2
	black blueberry	1	4	0	6/0	2
C	spike trisetum	10	5	60	6/4	2
	bluejoint small reed grass	5	5	0	6/4	2
	Columbia brome grass	3	5	20	6/4	2
	common cow-parsnip	5	5	40	6/0	2
	green false hellebore	2	4	20	6/0	2
	fireweed	30	7	100	6/0	2
	Arctic lupine	1	4	20	6/7	2
	wild strawberry	2	4	0	6/10	2
	fleabane	15	5	100	6/0	2
	bracted lousewort	2	4	0	6/7	2
	arrow-leaved ragwort	35	7	40	6/7	2
	common monkeyflower	1	4	0	6/7	2
	little-flowered buttercup	1	4	20	6/7	2
	palmate colt's-foot	10	5	60	6/0	2
	Sitka valerian	5	5	0	6/7	2
	wood-rush	2	5	40	6/4	2
	false Solomon's-seal	2	4	20	6/7	2
	northern twinflower	2	5	20	6/0	2
	blue-bead clintonia	5	5	20	6/0	2
	common dandelion	1	4	40	6/0	2
	common horsetail	1	4	20	6/0	2
	dwarf red blackberry	10	5	40	6/0	2
	trifoliate-leaved foamflower	1	4	40	6/0	2
	nodding trisetum	2	5	20	6/4	2
	showy aster	1	4	20	6/0	2
	Columbia lily	1	4	0	6/7	2
	pine grass	5	5	0	6/4	2
	Sitka columbine	2	5	0	6/7	2
	white hawkweed	1	4	20	6/7	2
	common red Indian paintbrush	1	4	0	6/7	2
	western fescue	1	4	20	6/4	2
	sandwort	1	4	20	6/7	2
	large-leaved avens	R	2	0	6/8	2
	rayless mountain ragwort	1	4	0	6/7	2
	sweet-scented bedstraw	1	4	20	6/7	2
	red baneberry	10	4	60	6/0	2
	western meadow-rue	2	5	20	6/0	2
	Canadian bunchberry	R	2	20	6/0	2
	sedge	R	2	0	6/7	2
	fringed grass-of-Parnasasus	1	5	20	6/7	2
	Douglas' water-hemlock	1	5	20	6/7	2
	cucumberroot twistedstalk	1	5	0	6/0	2
	oak fern	R	2	20	6/0	2

Table 3.7

Floristic Data - Gridpoint no. 29
(% C - Percent Canopy Cover, D - Distribution,
F - Total Frequency, P - Phenology, and V - Vigour)

LAYER	SPECIES	%C	D	F	P	V
B_2	lodgepole pine	2	4	0	6/0	2
	trembling aspen	5	5	0	6/0	2
	spruce hybrid	2	4	0	6/0	2
	alpine fir	2	4	0	6/0	2
	twinberry honeysuckle	3	5	0	6/7	2
	black blueberry	1	5	0	6/0	2
	black swamp gooseberry	30	5	20	6/10	2
	currant	2	3	0	6/0	2
	American red raspberry	15	4	20	6/0	2
C	false Solomon's-seal	2	4	0	6/7	2
	heart-leaved arnica	2	4	20	6/0	2
	western fescue	5	5	0	6/7	2
	common monkeyflower	R	4	0	6/7	2
	fireweed	60	7	80	6/0	2
	arrow-leaved ragwort	2	4	0	6/3	2
	common horsetail	7	7	20	6/0	2
	Canadian bunchberry	2	4	0	6/8	2
	palmate colt's-foot	10	5	20	6/0	2
	aster	5	5	0	6/0	2
	blue-bead clintonia	R	2	0	6/0	2
	little-flowered buttercup	R	2	0	6/8	2
	wood-rush	1	5	0	6/7	2
	common dandelion	R	2	0	6/9	2
	five-leaved creeping raspberry	2	5	0	6/0	2
	bedstraw	1	4	20	6/0	2
	white hawkweed	1	4	20	6/0	2
	yarrow	R	2	0	6/0	2
	western meadow-rue	R	2	0	6/0	2
	trifoliate-leaved foamflower	1	4	20	6/0	2
	red baneberry	1	4	20	6/0	2
	willowherb	2	5	20	6/0	2
D	Polytrichum juniperinum	1	5	0		
	Dicranum scoparium	1	5	0		
	Aulacomnium palustre	1	5	0		

Lonicera - Cornus: Pyrola variant

Before logging, van Barneveld (1971) described the vegetation as follows: the dense tree canopy was formed by alpine fir and spruce hybrids. The shrub layer was characterized by spruce hybrid regeneration and high bush cranberry. In addition, to false Solomon's-seal and pyrola, racemose pussytoes, Columbia brome grass, common mitrewort, five-stamened mitrewort, Arctic colt's-foot and unioliate-leaved foamflower were present in the herb layer. The well developed moss layer was formed by Pleurozium schreberi with patches of Rhytidadelphus triquetrus.

1981 Gridpoint Samples
Gridpoint 33 (Table 3.8)

Following logging, a sparse shrub canopy with minor amounts of lodgepole pine, alpine fir, and high bush cranberry are present. Spruce hybrid regeneration is absent. Instead, Sitka mountain alder is the dominant shrub. in the herb layer, of the two character species only false Solomon's-seal occurs. The herbs are diverse with fireweed, chickweed, spike trisetum, bluejoint small reed grass, showy aster, northern twinflower and blue-bead clintonia being common. Polytrichum juniperinum occurs sparsely.

Gridpoint 34 (Table 3.9)

Following logging, the sparse shrub canopy consists of lodgepole pine with minor amounts of trembling aspen. High bush cranberry, spruce hybrids and alpine fir are not present. In the herb layer false Solomon's-seal and Columbia brome grass have remained from the original variant. Also, fireweed, yarrow, hair bent grass and pine grass occur in the herb layer. Polytrichum juniperinum occurs sparsely.

Table 3.8

Floristic Data - Gridpoint no. 33
(% C - Percent Canopy Cover, D - Distribution,
F - Total Frequency, P - Phenology, and V - Vigour)

LAYER	SPECIES	%C	D	F	P	V
B_1	Sitka mountain alder	20	5	60	6/10	2
B_2	lodgepole pine	1	4	20	6/0	2
	alpine fir	3	4	0	6/0	2
	Sitka mountain alder	10	5			2
	western thimbleberry	4	5	0	6/0	2
	Oregon boxwood	4	5	40	6/0	2
	American red raspberry	2	5	0	6/10	2
	birch-leaved spirea	2	5	40	6/8	2
	black blueberry	1	5	0	6/0	2
	black swamp gooseberry	1	5	0	6/10	2
	high bush cranberry	1	4	0	6/10	2
C	red baneberry	1	4	0	6/10	2
	fireweed	15	7	100	6/7	2
	aster	3	4	40	6/7	2
	white hawkweed	1	4	60	6/9	2
	clover	1	5	40	6/9	2
	Arctic lupine	2	5	40	6/10	2
	yarrow	1	4	60	6/7	2
	chickweed	10	5	60	6/9	2
	hair bent grass	2	5	40	6/4	2
	spike trisetum	10	5	20	6/9	2
	blue wild rye grass	4	5	20	6/4	2
	bluejoint small reed grass	10	5	20	6/9	2
	western fescue	1	5	20	6/9	2
	wood reed grass	1	5	0	6/4	2
	showy aster	5	4	60	6/0	2
	heart-leaved arnica	4	4	0	6/0	2
	Canada hawkweed	1	4	0	6/7	2
	false Solomon's-seal	1	4	20	6/10	2
	western meadow-rue	1	4	20	6/0	2
	common pink pyrola	1	4	0	6/0	2
	Canadian bunchberry	4	4	20	6/10	2
	common pearly everlasting	1	4	20	6/7	2
	northern twinflower	5	5	40	6/0	2
	blue-bead clintonia	5	5	40	6/0	2
	pussytoes	1	4	20	6/0	2
	wild strawberry	4	4	20	6/0	2
	thistle	1	4	0	6/7	2
	Kentucky blue grass	3	4	40	6/4	2
	fowl blue grass	1	4	40	6/9	2
	Columbia lily	1	4	0	6/3	2
	colt's-foot	1	4	0	6/0	2
	cream-colored peavine	1	4	0	6/0	2
	Sitka columbine	1	4	20	6/0	2
	common timothy	1	4	20	6/9	2
	star-flowered false Solomon's-seal	1	4	0	6/0	2
D	Polytrichum juniperinum	3	5	20		
	Bryum sp.	1	5	20		
	Ceratodon purpureus	1	5	20		

Table 3.9

Floristic Data - Gridpoint no. 34
(% C - Percent Canopy Cover, D - Distribution,
F - Total Frequency, P - Phenology, and V - Vigour)

LAYER	SPECIES	%C	D	F	P	V
B_2	lodgepole pine	10	5	0	6/0	1
	trembling aspen	1	4	0	6/0	1
	twinberry honeysuckle	2	5	0	6/10	1
	Oregon boxwood	3	4	0	6/0	1
	American red raspberry	5	4	80	6/0	1
	western thimbleberry	2	4	0	6/0	1
	black swamp gooseberry	2	4	0	6/0	1
	Sitka mountain alder	3	4	0	6/10	1
	Sitka mountian ash	1	4	0	6/0	1
	birch-leaved spirea	1	4	0	6/10	1
	Drummond's willow	7	4	0	6/0	1
C	fireweed	25	7	80	6/9	1
	white hawkweed	2	4	80	6/8	1
	Arctic lupine	2	4	40	6/8	1
	aster	5	4	40	6/8	1
	yarrow	10	4	40	6/8	1
	thistle	1	4	40	6/8	1
	spike trisetum	5	5	20	6/8	1
	Canada hawkweed	1	4	20	6/8	1
	western fescue	1	4	20	6/8	1
	blue wild rye grass	2	5	0	6/10	1
	common dandelion	1	4	40	6/8	1
	showy aster	1	4	0	6/8	1
	wood horestail	3	5	20	6/4	1
	sedges	1	5	40	6/7	1
	cream-coloured peavine	1	4	20	6/8	1
	Columbia brome grass	1	4	0	6/8	1
	wild strawberry	1	5	0	6/8	1
	hair bent grass	10	5	20	6/8	1
	wood reed grass	1	5	40	6/8	1
	fowl blue grass	1	5	20	6/8	1
	clover	1	4	20	6/9	1
	chickweed	2	5	0	6/0	1
	red Indian paintbrush	1	4	0	6/9	1
	common monkeyflower	5	5	0	6/9	1
	wood-rush	1	5	0	6/7	1
	western meadow-rue	2	5	0	6/9	1
	false Solomon's-seal	1	4	0	6/9	1
	arrow-leaved colt's-foot	1	4	0	6/0	1
	cucumberroot twistedstalk	1	4	0	6/8	1
	beaked sedge	1	5	0	6/7	1
	lesser spear-leaved buttercup	3	5	20	6/8	1
	little meadow foxtail	8	5	20	6/8	1
	northern twinflower	1	5	0	6/0	1
	pine grass	5	5	0	6/8	1
	common horsetail	1	4	0	6/0	1
	bedstraw	1	4	0	6/10	1
D	Polytrichum juniperinum	5	5	60		

3.2.1.3 Pinus-Lupinus Community Type

The Pinus-Lupinus Community Type is located on exposed shallow colluvium over bedrock knolls. Van Barneveld (1971) states: the tree canopy has a homogenous stand of lodgepole pine. The shrub layer is dense with Oregon boxwood and black blueberry occurring. Constant herbs are heart-leaved arnica, Columiba lily and Arctic lupine. Often an interrupted moss layer of Pleurozium schreberi characterized this community type.

This type represents an open stand of vegetation with a slower rate of succession.

It includes one variant, Pinus-Lupinus: moss.

Pinus-Lupinus: moss variant

Before logging, van Barneveld (1971) describes the vegetation as follows: in addition to lodgepole pine and seral Rocky Mountain Douglas-fir the climax species - alpine fir was in the tree canopy. Twinberry honeysuckle, Scouler's willow, spruce hybrid and Rocky Mountain Douglas-fir regeneration were found in the open shrub layer. In the herb layer fireweed, white hawkweed and sickle-top lousewort always accompanied Columbia lily and Arctic lupine. The discontinuous moss layer was formed by Brachythecium albicans, Pleurozium schreberi and Dicranum fuscescens.

1981 Gridpoint Sample
Gridpoint 30 (Table 3.10)

After logging, the shrub layer is open with lodgepole pine, alpine fir and minor amounts of Rocky Mountain Douglas-fir regenerating. All character species are present except sickle-top lousewort and the mosses. Reoccurring in the low shrub layer in minor amounts are Oregon boxwood, black blueberry, twinberry honeysuckle and Scouler's willow. Pine grass dominates the dense herba-

Table 3.10

Floristic Data - Gridpoint no. 30
(% C - Percent Canopy Cover, D - Distribution,
F - Total Frequency, P - Phenology, and V - Vigour)

LAYER	SPECIES	%C	D	F	P	V
B_1	alpine fir	1	1	80	6/0	2
	Douglas-fir	3	1	20	6/0	2
B_2	lodgepole pine	20	4	20	6/0	2
	alpine fir	15	5	80	6/0	-
	Rocky Mountain Douglas-fir	5	4	20	6/0	-
	Scouler's willow	2	4	0	6/0	2
	birch-leaved spirea	3	4	60	6/7	1
	Oregon boxwood	5	5	80	6/0	2
	twinberry honeysuckle	1	4	0	6/10	2
	western mountain-ash	2	4	20	6/0	2
	bristly Nootka rose	1	4	0	6/10	2
	common saskatoon	1	1	0	6/0	2
	black blueberry	1	4	20	6/0	2
	common juniper	2	1	0	6/0	2
C	yarrow	30	7	40	6/7	2
	Arctic lupine	20	7	100	6/10	2
	Columbia lily	1	4	20	6/10	2
	pine grass	80	8	80	6/7	2
	western fescue	5	5	40	6/9	2
	white hawkweed	2	4	60	6/9	2
	racemose pussytoes	2	4	40	6/9	2
	wild strawberry	2	4	40	6/10	2
	western meadow-rue	1	4	20	6/0	2
	heart-leaved arnica	1	4	80	6/0	2
	fireweed	2	4	20	6/9	2
	northern bedstraw	15	5	100	6/0	2
	common dandelion	1	4	0	6/0	2
	bluejoint small reed grass	5	5	20	6/9	2
	showy aster	2	4	20	6/0	2
	yellow rattle	3	5	20	6/10	2
	Canadian bunchberry	1	4	20	6/0	2
	aster	1	4	40	6/7	2
	red Indian paintbrush	1	4	0	6/0	2
	false Solomon's-seal	1	4	20	6/0	2
	rayless mountain ragwort	1	3	0	6/9	2
	field pussytoes	1	5	0	6/9	2
	green pyrola	1	4	20	6/0	2
	spike trisetum	2	5	20	6/9	2
	American vetch	1	4	0	6/0	2
	green false hellebore	2	5	0	6/0	2
	northern bedstraw	2	5	0	6/0	2
	Alaska rein orchid	R	2	0	6/7	2
	willowherb	R	2	0	6/7	2
	Canada hawkweed	1	4	0	6/7	2
	bracted lousewort	1	1	0	6/9	2
	racemose pussytoes	1	5	0	6/9	2
D	Polytrichum juniperinum	5	5	0		

ceous layer. Other constant herbs are yarrow, Arctic lupine and northern twinflower. The moss Polytrichum juniperinum occurs in patches.

This variant occurs on shallow colluvium over bedrock. A minor amount of exposed bedrock is present.

3.2.1.4 Abies - shrub Community Type

Generally, the Abies - Shrub Community Type occurs on strong to extreme (20-50%) west-facing slopes. The tree canopy consists of an open dense stand of lodgepole pine with alpine fir, spruce hybrid and scattered Rocky Mountain Douglas-fir. Alpine fir is also regenerating in the shrub layer. The constantly occurring herbs are heart-leaved arnica and one-sided wintergreen. In the moss layer Pleurozium schreberi sometimes dominates along with Dicranum fuscescens.

One variant was recognized Abies-shrub: Clintonia.

Abies-shrub: Clintonia variant

Before logging, van Barneveld (1971) described the vegetation as follows: a nearly closed tree canopy of alpine fir, spruce hybrids, seral Rocky Mountain Douglas-fir and scattered lodgepole pine were present. The shrub layer was dense with Sitka mountain alder or white-flowered rhododendron dominating. Due to the closed tree canopy and the dense shrub layer a sparse herb layer exists with blue-bead clintonia and sickle-top lousewort occurring. Instability, of the soil caused an interupted distribution of Pleurozium schreberi.

1981 Gridpoint Sample
Gridpoint 25 (Table 3.11)

After logging, the gridpoint plot representing this variant is located on an area of severe disturbance - a logging "landing site". This disturbance has

Table 3.11

Floristic Data - Gridpoint no. 25
(% C - Percent Canopy Cover, D - Distribution,
F - Total Frequency, P - Phenology, and V - Vigour)

LAYER	SPECIES	%C	D	F	P	V
B_2	lodgepole pine	2	4	20	6/0	1
	spruce hybrid	R	1	0	6/0	1
	alpine fir	R	1	0	6/0	1
	willows	3	4	20	6/0	1
C	bluejoint small reed grass	10	5	20	6/4	1
	blue wild rye grass	1	5	0	6/4	1
	western fescue	1	5	20	6/8	1
	spike trisetum	15	5	80	6/9	1
	hair bent grass	7	5	80	6/4	1
	foxtail barley	1	5	0	6/8	1
	Kentucky blue grass	1	5	20	6/8	1
	fowl blue grass	1	5	0	6/8	1
	yarrow	10	7	80	6/7	1
	Canada hawkweed	1	4	20	6/7	1
	common dandelion	3	4	80	6/0	1
	fireweed	2	4	60	6/7	1
	aster	10	7	100	6/7	1
	clover	2	5	20	6/8	1
	sedge	1	5	20	6/4	1
	palmate colt's-foot	1	4	0	6/0	1
	Arctic lupine	1	4	0	6/10	1
	chickweed	1	5	60	6/9	1
	common timothy	1	5	0	6/8	1
	wood-rush	1	5	0	6/4	1
	heart-leaved arnica	1	2	20	6/0	1
	dwarf red blackberry	1	2	0	6/0	1
	pine grass	1	3	0	6/8	1
	wood reed grass	1	3	0	6/8	1

caused compaction of the soil thereby decreasing soil moisture availability and root penetration. The only character species present is heart-leaved arnica. The shrub layer is low and sparse with few lodgepole pine shrubs regenerating and scattered, well-browsed willow species. The community is composed mainly of herbs: bluejoint small reed grass, spike trisetum, yarrow and asters dominate. Mosses are absent and a considerable portion (30%) of the ground is unvegetated.

3.2.2 Interior Douglas-fir Zone

In the Interior Douglas-fir zone two community types were recognized. Pseudotsuga-Dicranum and Pinus-Hieracium.

3.2.2.1 Pseudotsuga-Dicranum Community Type

The Pseudotsuga-Dicranum Community Type occurs on soil developed on deep morainal or colluvial material. Van Barneveld (1971) states: this community type consists of a forest of lodgepole pine with Rocky Mountain Douglas-fir veterans. Rocky Mountain Douglas-fir is also regenerating in the dense shrub layer, in addition to common saskatoon, bristly Nootka rose, Scouler's willow and birch-leaved spirea. Constantly occurring herbs are showy aster, northwestern sedge, common red Indian paintbrush, large-leaved rattlesnake orchid and northern twinflower. A patchy moss layer of Dicranum scoparium is a constant feature of this community type.

Only one variant Pseudotsuga-Dicranum: Alnus is represented.

Pseudotsuga - Dicranum: Alnus variant

Before logging, van Barneveld (1971) described the vegetation as follows: in addition to the shrub species present in the community type often Sitka mountain alder, twinberry honeysuckle, spruce hybrids and western thimbleberry were present. Pine grass, fireweed, Arctic lupine, sickle top lousewort and frequently green pyrola and false Solomons's-seal occurred in the herb layer.

1981 Gridpoint Samples
Gridpoint 43 (Table 3.12)

Following logging, the present vegetation closely resembles the original community. Regenerating in the shrub layer is lodgepole pine, alpine fir, Rocky Mountain Douglas-fir, trembling aspen and spruce hybrid. Sitka mountain alder is the dominant shrub but, black blueberry has not regenerated as strongly compared to 1971. The species rich herbaceous layer is dominated by pine grass. The characteristic herbs northwestern sedge, large-leaved rattlesnake orchid and northern twinflower are absent.

Gridpoint 45 (Table 3.13)

Following logging, the present vegetation is very similar to the described variant. Again, Sitka mountain alder is the dominant shrub, however twinberry honeysuckle and western thimbleberry are absent. The herb layer is dominated by pine grass. Only the character herb large-leaved rattlesnake orchid is absent.

3.2.2.2 *Pinus-Hieracium* Community Type

Pinus-Hieracium community type occurs on a wide range of genetic materials. This mature seral community type has a dense lodgepole pine tree canopy. In the herb layer, large-leaved rattlesnake orchid and white hawkweed are always present.

Two variants of this community type are represented: *Pinus-Hieracium*: *Rosa* and *Pinus-Hieracium*: *Lonicera*.

Pinus-Hieracium: *Rosa* variant

Before logging, van Barneveld (1971) described the vegetation as follows: in addition to lodgepole pine the tree canopy was formed by spruce hybrid and

Table 3.12

Floristic Data - Gridpoint no. 43
(% C - Percent Canopy Cover, D - Distribution,
F - Total Frequency, P - Phenology, and V - Vigour)

LAYER	SPECIES	%C	D	F	P	V
A_2	trembling aspen	1	1	0	6/0	2
B_1	lodgepole pine	2	2	0	6/0	2
	alpine fir	1	1	0	6/0	2
	Rocky Mountain Douglas-fir	5	4	0	6/0	2
	trembling aspen	2	2	0	6/0	2
B_2	lodgepole pine	3	4			
	alpine fir	10	5			
	Rocky Mountain Douglas-fir	5	5			
	trembling aspen	3	4			
	black swamp gooseberry	2	4	0	6/0	2
	black blueberry	2	4	0	6/0	2
	Sitka mountain alder	15	5	40	6/10	2
	soopolallie	3	3	20	6/10	2
	prickly rose	2	4	20	6/0	2
	willow	3	4	0	6/0	2
	western thimbleberry	2	4	0	6/0	2
	birch-leaved spirea	1	4	40	6/0	2
	twinberry honeysuckle	1	2	0	6/9	2
	high bush cranberry	1	3	0	6/0	2
	Oregon boxwood	2	4	20	6/0	2
	spruce hybrid	2	4	0	6/0	2
	common saskatoon	1	3	0	6/0	2
	willow	2	2	0	6/0	2
C	wild strawberry	8	10	40	6/7	2
	yarrow	1	4	60	6/0	2
	fireweed	5	4	60	6/0	2
	blue wild rye grass	5	5	20	5/0	2
	pine grass	50	7	80	5/0	2
	heart-leaved arnica	2	4	40	6/0	2
	dwarf red blackberry	1	2	0	6/0	2
	Arctic lupine	1	4	20	6/7	2
	northern twinflower	2	3	0	6/0	2
	Canadian bunchberry	2	4	60	6/0	2
	aster	R	2	0	6/0	2
	western meadow-rue	R	2	0	6/0	2
	showy aster	1	2	40	6/0	2
	aster	1	2	20	6/0	2
	palmate colt's-foot	1	2	0	6/0	2
	red Indian paintbrush	1	2	20	6/7	2
	Columbia lily	R	2	0	6/0	2
	bracted lousewort	1	2	0	6/3	2
	red baneberry	R	1	0	6/9	2
	Smith's fairybells	R	1	0	6/0	2
	false Solomon's-seal	R	2	0	6/7	2
	violet	R	2	0	6/0	2
D	Mnium sp.	1	1	0		

Table 3.13

Floristic Data - Gridpoint no. 45
(% C - Percent Canopy Cover, D - Distribution,
F - Total Frequency, P - Phenology, and V - Vigour)

LAYER	SPECIES	%C	D	F	P	V
B_1	lodgepole pine	3	4	60	6/0	2
	Rocky Mountain Douglas-fir	8	4	0	6/0	2
	trembling aspen	7	5	20	6/0	2
	Sitka mountain alder	40	5	40	6/10	2
	willows	5	4	0	6/0	2
B_2	lodgepole pine	20	7			
	white spruce	3	4	20	6/0	2
	trembling aspen	3	5			
	black cottonwood	R	2	0	6/0	2
	bristly Nootka rose	2	4	20	6/0	2
	Oregon boxwood	2	4	40	6/0	2
	black blueberry	3	5	40	6/0	2
	kinnikinnick	7	5	0	6/0	2
	tall Oregon-grape	1	4	0	6/0	2
	birch-leaved spirea	1	4	20	6/4	2
	willows	2	4	0	6/0	
	common saskatoon	1	4	20	6/0	2
	soopolallie	1	3	0	6/0	2
C	green pyrola	R	4	20	6/0	2
	blue wild rye grass	1	5	20	6/4	2
	white hawkweed	2	4	60	6/7	2
	dwarf red blackberry	2	5	40	6/0	2
	Canadian bunchberry	2	5	80	6/0	2
	wild strawberry	3	5	40	6/8	2
	heart-leaved arnica	1	5	40	6/0	2
	fireweed	2	4	60	6/4	2
	racemose pussytoes	1	4	0	6/9	2
	yarrow	1	4	0	6/7	2
	northern twinflower	4	5	100	6/0	2
	red Indian paintbrush	1	4	40	6/7	2
	Columbia lily	1	4	0	6/7	2
	northern gentian	1	4	0	6/7	2
	pine grass	70	5	100	6/3	2
	Columiba brome grass	5	8	0	6/4	2
	fleabane	2	5	20	6/0	2
	little-flowered buttercup	R	2	0	6/9	2
	Arctic lupine	2	5	40	6/7	2
	rosy pussytoes	1	4	0	6/7	2
	showy aster	1	4	20	6/0	2
	sickle-top lousewort	2	5	0	6/7	2
	bracted lousewort	1	4	0	6/8	2
	sedges	1	5	0	6/7	2
	rayless mountain ragwort	1	4	0	6/7	2
	western blue clematis	R	4	20	6/0	2
	common dandelion	1	4	0	6/0	2
D	Polytrichum juniperinum	3	5	40		
	Dicranum polysetum	2	5	0		

Rocky Mountain Douglas-fir. The tall shrub layer consisted of a minor amount of spruce regeneration, while twinberry honeysuckle, bristly Nootka rose, soopolallie, birch-leaved spirea, Sitka mountain alder, Sitka mountain-ash and high bush cranberry make up the well developed low shrub layer. Pine grass dominated the herb layer, other herbs present were yarrow, field pussytoes, showy aster, northwestern sedge, fireweed, wild strawberry, northern twinflower and Arctic lupine. Often, western pipsissewa, blue-bead clintonia, fuzzy-spiked wild rye grass, ground cedar and occasionally spike trisetum were additional herbs. Small quantities of Brachythecium albicans were often present.

1981 Gridpoint Sample
Gridpoint 42 (Table 3.14)

After logging, the moderate shrub layer has lodgepole pine regenerating in addition to white spruce, alpine fir and Rocky Mountain Douglas-fir. The other shrubs dominating are Sitka mountain alder and soopolallie. Similarly, to the original variant, pine grass is still the dominant character species in the herb layer. Other constantly occurring herbs are yarrow, field pussytoes, showy aster, fireweed, wild strawberry, northern twinflower, Arctic lupine, false Solomon's-seal and white hawkweed. The only character species absent are northwestern sedge, green pyrola and large-leaved rattlesnake orchid. Small patches of Polytrichum juniperinum replaced Brachythecium albicans.

Pinus-Hieracium: Lonicera variant

Before logging, van Barneveld (1971) described the vegetation as follows: in addition to the community type charcteristics Rocky Mountain Douglas-fir was sparsely regenerating in the tall shrub layer. In the open to dense low shrub layer was twinberry honeysuckle, black swamp gooseberry, western thimbleberry, birch-leaved spirea, and high bush cranberry. The well developed herb layer consisted of asters, Canadian bunchberry, western fescue, wild strawberry, sweet-scented bedstraw, white hawkweed, northern twinflower, one-sided wintergreen, green pyrola, dwarf red blackberry, false Solomon's-seal, western

Table 3.14

Floristic Data - Gridpoint no. 42
(% C - Percent Canopy Cover, D - Distribution,
F - Total Frequency, P - Phenology, and V - Vigour)

LAYER	SPECIES	%C	D	F	P	V
B_1	lodgepole pine	10	4	40	6/0	2
	white spruce	10	5	40	6/0	2
	alpine fir	7	4	0	6/0	2
	Rocky Mountain Douglas-fir	3	2	0	6/0	2
	willow	5	4	0	6/0	2
	Sitka mountain alder	20	5	40	6/10	2
B_2	lodgepole pine	20	4			
	white spruce	5	4			
	alpine fir	10	4			
	western thimbleberry	3	5	20	6/0	2
	soopolallie	15	5	40	6/10	2
	Oregon boxwood	3	5	40	6/10	2
	black blueberry	3	5	20	6/0	2
	bristly Nootka rose	3	5	40	6/0	2
	common saskatoon	1	5	20	6/0	2
	tall Oregon-grape	1	5	0	6/0	2
	birch-leaved spirea	2	5	0	6/0	2
	twinberry honeysuckle	1	5	0	6/0	2
	black swamp gooseberry	1	5	0	6/0	2
	Scouler's willow	1	4	0	6/0	2
	willows	5	4	0	6/0	2
C	fireweed	5	4	100	6/0	2
	pine grass	80	8	80	6/0	2
	Arctic lupine	15	4	60	6/7	2
	showy aster	3	4	0	6/0	2
	white hawkweed	1	4	80	6/7	2
	Canadian bunchberry	3	4	60	6/0	2
	northern twinflower	3	4	60	6/0	2
	heart-leaved arnica	3	4	80	6/0	2
	blue wild rye grass	1	5	0	6/4	2
	racemose pussytoes	1	5	0	6/8	2
	Columbia lily	1	4	20	6/7	2
	sickle-top lousewort	1	4	0	6/8	2
	yarrow	2	4	40	6/0	2
	Columbia brome grass	2	4	0	6/4	2
	spike trisetum	2	4	0	6/4	2
	wild strawberry	2	4	40	6/0	2
	black blueberry	2	4	40	6/0	2
	aster	2	4	40	6/0	2
	cream-colored peavine	1	4	0	6/7	2
	bluejoint small reed grass	1	4	20	6/4	2
	false Solomon's-seal	1	4	0	6/0	2
	western meadow-rue	1	4	0	6/0	2
	northern gentian	1	4	0	6/7	2
	fragrant white rein orchid	1	4	20	6/7	2
	wood-rush	1	4	20	6/7	2
	common monkeyflower	1	4	0	6/7	2
	palmate colt's-foot	2	5	20	6/0	2
	sedge	2	5	0	6/4	2
	common dandelion	1	4	0	6/0	2
	red clover	R	4	0	6/7	2
	willowherb	1	4	0	6/7	2
	arrow-leaved ragwort	R	2	0	6/7	2
	horsetail	1	4	20	6/0	2
	thistle	R	2	0	6/4	2
	hair bent grass	1	5	0	6/4	2
	large-leaved avens	R	2	0	6/10	2
	Kentucky blue grass	1	4	0	6/4	2
	American manna grass	1	4	0	6/4	2
	western fescue	1	4	0	6/4	2
D	Polytrichum juniperinum	5	5	40		

meadow-rue and occasionally bluejoint small reed grass, Arctic colt's-foot and unifoliate-leaved foamflower were present. In the moss layer Dicranum scoparium and often Dicranum fuscescens and Ptilium crista-castrensis were found.

1981 Gridpoint Samples
Gridpoint 35 (Table 3.15)

Following logging, lodgepole pine dominates the shrub layer. Rocky Mountain Douglas-fir and alpine fir are present. Due to the density of lodgepole pine the remaining shrub species are either absent (western thimbleberry and high bush cranberry) or are present in minor amounts. Many species are absent from the herb layer -Canadian bunchberry, sweet-scented bedstraw, one-side wintergreen, green pyrola and large-leaved rattlesnake orchid. Arctic lupine and grasses dominate the herb layer. Dicranum species occur in patches.

This plot occurs on imperfectly drained, medium textured soil on morainal material. The soil is classified as a Gleyed Brunisolic Gray Luvisol.

Gridpoint 41 (Table 3.16)

Following logging, lodgepole pine is regenerating in the low shrub layer. The remaining species in the shrub layer occur only in minor amounts. The dense herb layer consists mainly of fireweed, grasses and wood-rush. Polytrichum juniperinum occurs in patches and replaces the former variant's species.

Table 3.15

Floristic Data - Gridpoint no. 35
(% C - Percent Canopy Cover, D - Distribution,
F - Total Frequency, P - Phenology, and V - Vigour)

LAYER	SPECIES	%C	D	F	P	V
B_2	lodgepole pine	60	7	60	6/0	2
	alpine fir	2	2	40	6/0	2
	Rocky Mountain Douglas-fir	1	1	0	6/0	2
	willow	2	4	20	6/0	2
	Sitka mountain alder	2	2	40	6/10	2
	birch-leaved spirea	10	4	80	6/0	2
	black blueberry	5	4	40	6/0	2
	Oregon boxwood	2	5	0	6/0	2
	Wood's rose	7	4	60	6/0	2
	twinberry honeysuckle	1	2	20	6/0	2
	soopolallie	1	4	0	6/0	2
	black swamp gooseberry	1	4	0	6/0	2
	kinnikinnick	1	2	0	6/0	2
C	Arctic lupine	20	7	100	6/7	2
	Canadian bunchberry	3	4	80	6/0	2
	northern twinflower	10	5	100	6/0	2
	showy aster	2	4	20	6/0	2
	white hawkweed	1	4	0	6/0	2
	fireweed	2	4	0	5/0	2
	field pussytoes	2	4	0	6/7	2
	yarrow	4	7	80	6/0	2
	Lindley's aster	4	7	0	5/0	2
	wild strawberry	1	4	20	6/0	2
	aster	4	7	20	5/0	2
	palmate colt's-foot	1	2	20	6/0	2
	marsh horsetail	1	2	0	6/0	2
	dwarf red blackberry	1	2	20	6/0	2
	heart-leaved arnica	1	2	20	6/0	2
	false Solomon's-seal	1	2	20	6/0	2
	western fescue	40	8	40	6/0	2
	western meadow-rue	2	5	20	6/9	2
	blue wild rye grass	2	5	0	6/0	2
	Canada hawkweed	1	4	0	6/7	2
D	Polytrichum juniperinum	10	5	60		
	Pleurozium schreberi	1	4	0		

Table 3.16

Floristic Data - Gridpoint no. 41
(% C - Percent Canopy Cover, D - Distribution,
F - Total Frequency, P - Phenology, and V - Vigour)

LAYER	SPECIES	%C	D	F	P	V
B_2	lodgepole pine	40	4	100	6/0	2
	trembling aspen	1	1	0	6/0	2
	western thimbleberry	3	5	20	6/0	2
	willow	1	2	0	6/10	2
	Sitka mountain alder	7	5	40	6/10	2
	Sitka mountain-ash	1	3	0	6/5	2
	Oregon boxwood	5	5	0	6/9	2
	prickly rose	2	5	20	6/3	2
	twinberry honeysuckle	3	4	0	6/8	2
	alpine fir	3	2	0	6/0	2
	birch-leaved spirea	2	5	20	6/5	2
	black swamp gooseberry	1	4	0	6/5	2
	black cottonwood	1	4	0	6/0	2
	black blueberry	1	2	0	6/0	2
	common saskatoon	2	5	60	6/0	2
	white spruce	1	2	20	6/0	2
C	showy aster	4	4	20	6/0	2
	yarrow	3	4	60	4/0	2
	northern twinflower	8	5	80	6/0	2
	field pussytoes	2	4	0	6/6	2
	heart-leaved arnica	8	4	40	6/0	2
	racemose pussytoes	3	4	0	6/0	2
	Kentucky blue grass	30	7	100	6/0	2
	club-moss	1	2	0	6/0	2
	mountain sweetcicely	1	2	0	6/0	2
	common red Indian paintbrush	1	2	0	6/6	2
	false Solomon's-seal	1	1	0	6/3	2
	Lindley's aster	5	4	0	6/0	2
	white hawksweed	2	4	0	6/0	2
	Arctic lupine	8	4	80	6/6	2
	curved alpine wood-rush	10	5	0	6/6	2
	dwarf red blackberry	3	4	20	6/0	2
	bedstraw	2	5	0	6/0	2
	blue wild rye grass	2	5	20	6/0	2
	common dandelion	1	2	0	6/0	2
	Columbia lily	1	2	0	6/0	2
	Canadian bunchberry	4	4	60	6/8	2
	fireweed	15	7	100	6/0	2
	western meadow-rue	1	4	0	5/0	2
	wild strawberry	2	4	40	6/6	2
	little-flowered buttercup	1	1	0	6/6	2
	blue-bead clintonia	1	2	20	6/0	2
	big-leaved sandwort	1	2	0	6/6	2
D	Polytrichum juniperinum	20	5	20		

4. DISCUSSION OF SUCCESSIONAL TRENDS

The project area which was disturbed by logging, presently supports a wide variety of both residual and invader species. Invader species are species not present in the original unlogged stand (Dyrness, 1973). Even though invaders are present, a general similarity between the young seral community and the pre-logged community is discernible. The proportion of shrub species relative to that of herbs has increased with logging. Dyrness (1973) found that on disturbed sites shrub species are frequently the principal component and the herbaceous layer is usually dominated by invading species and the residuals may be relatively inconspicous.

Following logging, the species that survive and continue (residuals) and the new species that invade depend on a number of factors: competition for light, a change in soil moisture due to reduced transpiration or increased evaporation, an altered nutrient regime of the ecosystem, excessive soil temperatures or surface temperatures, shade tolerance, available rooting structures and seed source (eg. abundance of seed).

Engelmann spruce - Subalpine fir Zone

A few herbaceous plants, large-leaved rattlesnake orchid, few-flowered one-sided wintergreen, mountain sweetcicely, and evergreen yellow violet were consistently absent. Large-leaved rattlesnake orchid and few-flowered one-sided wintergreen have a rooting structure that could be easily disturbed. They have fibrous roots and rhizomes (underground stem) which grow mostly in the duff layer or between it and the mineral soil (McLean, 1969). Dyrness (1973) in his study on plant succession following logging also found that large-leaved rattlesnake orchid did not regenerate.

With the exception of edaphically strongly modified sites, Oregon boxwood, heart-leaved arnica and Pleurozium scheberi were found throughout the study

area (van Barneveld, 1971) before logging. In most cases, two out of three of these plants remained after logging. Pleurozium schreberi was replaced by shade-intolerant mosses. Heart-leaved arnica invades areas rapidly because of it's wind-borne seed and Oregon boxwood has a taproot system of growth which is not easily destroyed by logging (McLean, 1969).

Whenever the shrub layer was dense, the herb layer was lower in canopy coverage but, a diversity of species was present. This was especially true under Sitka mountain alder. It could be accounted for by a higher nitrogen content in the soil promoting a greater development of understory (Franklin and Pechanec, 1968).

Interior Douglas-fir Zone

Again, large-leaved rattlesnake orchid did not survive following logging. Western thimble-berry remained because it prefers disturbed unburned sites (Dyrness, 1973). Pine grass persisted throughout the disturbance due to its fibrous roots and rhizomes which grow up to 5 cm below the mineral soil surface (McLean, 1969).

There are several species that consistently occur. Fireweed, showy aster, white hawkweed and heart-leaved arnica invade areas rapidly because of their wind-borne seed. Arctic lupine and cream-coloured peavine have the ability to regenerate from the taproot even when the entire crown is destroyed. They can send up shoots and set seed the first year after a fire (McLean, 1969).

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APPENDIX A
DEFINITIONS

This appendix contains the definitions for percent canopy cover (%C), distribution (D), total frequency (F), phenology (P) and vigour (V). The terms and codes used are taken from Walmsley *et al*.

The plant species are listed under the general headings A, B, C, and D, which represent trees, shrubs, herbs and mosses and lichens respectively. More specifically:

A_2 - main tree canopy cover above 10 m in height.

B_1 - woody plants between 2 m and 10 m tall; shrubs and advanced tree regeneration.

B_2 - woody plants less than 2 m high; shrubs and established tree regeneration.

C - herbaceous species, regardless of their height, and some low woody plants.

D - mosses, lichens and tree seedlings growing on the dominant substrate.

The percent ocular cover is an estimate of the percent of the ground area covered by a vertical projection of the crown on to the ground surface. Occasionally, instead of perecentage the letter R is used to refer to rare species.

The term distribution refers to the spatial pattern of individuals of each species. For simplicity, the distribution is expressed as a number. The following explains the distribution codes.

Distribution Codes

CLASS	DESCRIPTION
1	rare individual, a single occurrence
2	a few sporadically occurring individuals
3	a single patch or clump of a species
4	several sporadically occurring individuals
5	a few patches or clumps of a species
6	several well spaced patches or clumps
7	continuous uniform occurrence of well spaced individuals
8	continuous occurrence of a species with a few gaps in the distribution
9	continuous dense occurrence of a species

Species frequency is dependent upon the presence or absence of a species from the subplot. For each of the five subplots the presence of a species was checked. The total frequency (F) is expressed as a precentage of subplots the species was present in. If the species was not present in any of the subplots the frequency percentage is 0.

The species frequency is an objective measure for monitoring changes in the vegetation.

Phenology refers to the stages a plant may go through in it's annual life cycle. This characterizes stages from germination to death, that is the bud, leaf and shoot development, then the emergence of flowers and fruit. The following gives the set of codes used. Both the vegetative and generative codes are recorded. The code consists of: a number indicating vegetative phenological state on left and after the slash the generative phenology.

Phenology Codes

VEGETATIVE				GENERATIVE
a) Deciduous Tree or Shrub		d) Conifer		
0	Closed bud	0	Closed bud	0 Without blossom bud
1	Buds with green tips	1	Swollen bud	1 Blossom buds recognizable
2	Green leaf out but not folded	2	Split bud	2 Blossom buds strongly swollen
3	Leaf unfolding up to 25%	3	Shoot capped	3 Shortly before flowering
4	Leaf unfolding up to 50%	4	Shoot elongate	4 Beginning flowering
5	Leaf unfolding up to 75%	5	Shoot full length, lighter green	5 In bloom up to 25%
6	Full leaf unfolding	6	Shoot mature, equally green	6 In bloom up to 50%
7	First leaves turned yellow			7 Full bloom
8	Leaf yellowing up to 50%			8 Fading
9	Leaf yellowing over 50%			9 Completely faded
10	Bare			10 Bearing fruit
b) Herbs				0 Without blossom buds
0	Without shoots above ground			1 Blossom buds recognizable
1	Shoots without unfolded leaves			2 Blossom buds strongly swollen
2	First leaf unfolds			3 Shortly before flowering
3	2 to 3 leaves unfolded			4 Beginning bloom
4	Several leaves unfolded			5 Up to 25% in blossom
5	Almost all leaves unfolded			6 Up to 50% in blossom
6	Plant fully developed			7 Full bloom
7	Stem and/or first leaves fading			8 Fading
8	Yellowing up to 50%			9 Completely faded
9	Yellowing over 50%			10 Yielding fruit
10	Dead			
c) Grasses				0 Without recognizable inflorescence
0	Without shoots above ground			1 Inflorescence recognizable, closed
1	Shoots without unfolded leaves			2 Inflorescence partly visable
2	First leaf unfolded			3 Inflorescence fully visable, not unfolded
3	2-3 leaves unfolded			4 Inflorescence unfolded
4	Beginning development of blades of grass			5 First blooms pollenizing
5	Blades partly formed			6 Up to 50% pollenized
6	Plants fully developed			7 Full bloom
7	Blades and/or first leaves turning yellow			8 Fading
8	Yellowing up to 50%			9 Fully faded
9	Yellowing over 50%			10 Bearing fruit
10	Dead			
e) Ferns				0 Sori absent
0	Without shoots above ground			1 Sori green, forming
1	Rolled fronds above ground			2 Sori mature, darker, drier
2	First frond unfolds			3 Sori depression, strobili forming in lycopodium
3	2 to 3 fronds unfolded			
4	Several fronds unfolded			
5	Almost all fronds unfolded			
6	Plant fully developed			
7	First fronds fading			
8	Yellowing up to 50%			
9	Yellowing over 50%			
10	Dead			

Lastly, vigor allows comparison of the growth of a species on different sites and is assessed in relation to the range of growth of a species under particular climatic conditions (e.g. subzone), rather than the whole range of the species. Vigor is assessed and noted using a five-class scale.

Vigour Ratings

DESCRIPTION	SYMBOL
Species Dead	0
Vigor Poor	+
Vigor Fair	1
Vigor Good	2
Vigor Excellent	3

APPENDIX B
LIST OF PLANT NAMES

This appendix contains a list of plants located on the gridpoint plots. The list includes common and botanical names. The common names for the trees and forbs are according to Taylor and MacBryde (1977), the mosses are according to Crum et al. (1973), the liverworts are according to Stotler and Crandall - Stotler (1977) and the lichens are according to Hale and Culberson (1970).

COMMON NAME	BOTANICAL NAME
Tree Layer	
alpine fir	*Abies lasiocarpa*
Douglas-fir	*refers to Pseudotsuga menziesii*
fir	*refers to Abies lasiocarpa*
lodgepole pine	*Pinus contorta*
pine	*Pinus contorta*
Rocky Mountain Douglas-fir	*Pseudotsuga menziesii var glauca*
spruce hybrid	*Picea glauca x Picea engelmannii*
Shrub Layer	
alder	*refers to Alnus viridis subsp. sinuata*
American red raspberry	*Rubus idaeus*
black blueberry	*Vaccinium membranaceum*
black cottonwood	*Populus balsamifera subsp. trichocarpa*
black swamp gooseberry	*Ribes lacustre*
birch-leaved spirea	*Spiraea betulifolia subsp. lucida*
bristly Nootka rose	*Rosa nutkana*
common saskatoon	*Amelanchier alnifolia*
currant	*refers to Ribes lacustre*

COMMON NAME	BOTANICAL NAME
Shrub Layer (Continued)	
Drummond's willow	*Salix drummondiana*
high bush cranberry	*Viburnum edule*
honeysuckle	*refers to Lonicera involucrata*
kinnikinnick	*Arctostaphylos uva-ursi*
Oregon boxwood	*Paxistima myrsinites*
prickly rose	*Rosa acicularis*
rose	*refers to Rosa nutkana*
Scouler's willow	*Salix scouleriana*
Sitka mountain alder	*Alnus viridis subsp. sinuata*
Sitka mountain-ash	*Sorbus sitchensis*
soopolallie	*Shepherdia canadensis*
tall Oregon-grape	*Mahonia aquifolium*
trembling aspen	*Populus tremubides*
twinberry honeysuckle	*Lonicera involucrata*
western thimbleberry	*Rubus parviflorus subsp. parviflorus*
white spruce	*Picea glauca*
willow	*Salix sp.*
Herbs	
Alaska rein orchard	*Platanthera unalascensis subsp. unalascensis*
American manna grass	*Glyceria grandis*
American vetch	*Vicia americana*
Arctic colt's-foot	*Petasites frigidus*
Arctic lupine	*Lupinus arcticus*
arrow-leaved colt's-foot	*Petasites sagittatus*
arrow-leaved ragwort	*Senecio triangularis*
asters	*Aster sp.*

COMMON NAME	BOTANICAL NAME
Herbs (Continued)	
beaked sedge	*Carex rostrata*
bedstraw	*Galium sp.*
big-leaved sandwort	*Moehringia macrophylla*
blue-bead clintonia	*Clintonia uniflora*
bluejoint small reed grass	*Calamagrostis canadensis*
blue wild rye grass	*Elymus glaucus*
bracted lousewort	*Pedicularis bracteosa*
bunchberry	*refers to Cornus canadensis*
Canada hawkweed	*Hieracium canadense*
Canadian bunchberry	*Cornus canadensis*
chickweed	*Cerastium sp.*
clover	*Trifolium sp.*
clintonia	*refers to Clintonia uniflora*
club-moss	*Lycopodium sp.*
Columbia brome grass	*Bromus vulgaris*
Columbia lily	*Lilium columbianum*
colt's-foot	*Petasites sp.*
common cow-parsnip	*Heracleum sphondylium subsp. montanum*
common dandelion	*Taraxacum officinale*
common horsetail	*Equisetum arvense*
common monkeyflower	*Mimulus guttatus*
common pearly everlasting	*Anaphalis margaritacea*
common pink pyrola	*Pyrola asarifolia*
common red Indian paintbrush	*Castilleja miniata*
common timothy	*Phleum pratense*
common western pipsissewa	*Chimaphila umbellata subsp. occidentalis*
cream-coloured peavine	*Lathyrus ochroleucus*
cucumberroot twistedstalk	*Streptopus amplexifolius*

COMMON NAME	BOTANICAL NAME
Herbs (Continued)	
curved alpine wood-rush	*Luzula arcuata*
Douglas' water-hemlock	*Cicuta douglasii*
dwarf red blackberry	*Rubus pubescens*
evergreen yellow violet	*Viola orbiculata*
false Solomon's-seal	*Smilacina racemosa*
field pussytoes	*Antennaria neglecta*
fireweed	*Epilobium angustifolium*
five-leaved creeping raspberry	*Rubus pedatus*
five-stamened mitrewort	*Mitella pentandra*
fleabane	*Erigeron sp.*
foamflower	*refers to Tiarella unifoliata*
fowl blue grass	*Poa palustris*
fowl manna grass	*Glyceria striata*
foxtail barley	*Hordeum jubatum*
fragrant white rein orchid	*Platanthera dilatata*
fringed grass-of-parnassus	*Parnassia fimbriata*
fuzzy-spiked wild rye grass	*Elymus innovatus var. innovatus*
green false hellebore	*Veratrum viride subsp. eschscholtzii*
green pyrola	*Pyrola chlorantha*
ground cedar	*Lycopodium complanatum*
hair bent grass	*Agrostis scabra*
hawkweed	*Hieracium sp.*
heart-leaved arnica	*Arnica cordifolia*
horsetail	*refers to Equisetum palustre*
Kentucky blue grass	*Poa pratensis*
large-leaved avens	*Geum macrophyllum*
large-leaved rattlesnake orchid	*Goodyera oblongifolia*
lesser pyrola	*Pyrola minor*
lesser spear-leaved buttercup	*Ranunculus flammula*

COMMON NAME	BOTANICAL NAME
Herbs (Continued)	
Lindley's aster	*Aster ciliolatus*
little-flowered buttercup	*Ranunculus uncinatus*
little meadow foxtail	*Alopecurus aequalis*
lupine	*Lupinus sp.*
marsh horsetail	*Equisetum palustre*
mitrewort	*Mitella sp.*
mountain sweetcicely	*Osmorhiza chilensis*
nodding trisetum	*Trisetum cernum*
northern gentian	*Gentianella amarella*
northern twinflower	*Linnaea borealis*
northwestern sedge	*Carex concinnoides*
oak fern	*Gymnocarpium dryopteris*
one-flowered wintergreen	*Moneses uniflora var. uniflora*
one-sided wintergreen	*Orthilia secunda*
palamate colt's-foot	*Petasites palmatus*
pine grass	*Calamagrostis rubescens*
pussytoes	*Antennaria sp.*
pyrola	*refers to Pyrola chlorantha*
racemose pussytoes	*Antennaria racemosa*
rayless mountain ragwort	*Senecio indecorus*
red baneberry	*Actaea rubra*
red clover	*Trifolium pratense*
rosy pussytoes	*Antennaria microphylla*
sandwort	*Arenaria sp.*
sedge	*Carex sp.*
Scribner's small reed grass	*Calamagrostis scribneri*
showy aster	*Aster conspicuus*
sickle-top lousewort	*Pedicularis racemosa*
simple-stemmed twistedstalk	*Streptopus roseus*

COMMON NAME	BOTANICAL NAME
Herbs (Continued)	
Sitka columbine	*Aquilegia formosa*
Sitka valerian	*Valeriana sitchensis*
slender rein orchard	*Platanthera unalascensis*
Smith's fairybells	*Disporum smithii*
spike trisetum	*Trisetum spicatum*
spiny shield fern	*Dryopteris assimilis*
star-flowered false Solomon's-seal	*Smilacina stellata*
sweet-scented bedstraw	*Galium triflorum*
thistle	*Cirsium sp.*
trifoliate-leaved foamflower	*Tiarella trifoliata*
unifoliate-leaved foamflower	*Tiarella unifoliata*
violet	*Viola sp.*
western blue clematis	*Clematis occidentalis subsp. grosseserrata*
western fescue	*Festuca occidentalis*
western meadow-rue	*Thalictrum occidentale*
Wheeler's blue grass	*Poa nervosa*
white hawkweed	*Hieracium albiflorum*
wild strawberry	*Fragaria virginana*
willowherb	*Epilobium sp.*
wood reed grass	*Cinna latifolia*
wood-rush	*Luzula sp.*
yarrow	*Achillea millefolium*
yellow rattle	*Rhianthus minor*

COMMON NAME	BOTANICAL NAME
Bryophyte Layer	
Mosses	
	Aulacomnium androgynum
	Aulacomnium palustre
	Brachythecium albicans
	Brachythecium sp.
	Bryum sp.
	Ceratodon purpureus
	Dicranum fuscescens
	Dicranum polysetum
	Dicranum scoparium
	Mnium insigne
	Mnium sp.
	Pleurozium schreberi
	Polytrichum juniperinum
	Ptilium crista-castrensis
	Rhytidiadelphus triquetrus
Liverworts	
	Calypogeja sp.
	Marchantia polymorpha

APPENDIX C
SPECIES COMPOSITION BY VARIANT (1971)

The following tables were extracted from van Barneveld (1971). They contain a list of plant species by variant. The community type character species were added.

Table C.1
Cornus-moss Community Type, Ribes Variant
in the Engelmann Spruce - Subalpine Fir Zone

ALWAYS PRESENT		IMPORTANT ASSOCIATES	
Layer	Species	Layer	Species
A_2	lodgepole pine	A_1	Rocky Mountian Douglas-fir
B_1	Sitka mountain alder alpine fir	A_2	alpine fir spruce hybrid
B_2	Sitka mountain alder black swamp gooseberry western thimbleberry Sitka mountain-ash alpine fir	B_2	common saskatoon bristly Nootka rose birch-leaved spirea
C	blue-bead clintonia Canadian bunchberry western fescue mountain sweetcicely one-sided wintergreen dwarf red blackberry false Solomon's-seal western meadow-rue evergreen yellow violet large-leaved rattlesnake orchid sweet-scented bedstraw	C	showy aster northwestern sedge
D	alpine fir seedlings	D	Ptilium crista-castrensis

Table C.2

Cornus-moss Community Type, Tiarella Variant
in the Engelmann Spruce - Subalpine Fir Zone

ALWAYS PRESENT		IMPORTANT ASSOCIATES	
Layer	Species	Layer	Species
A_2	alpine fir	B_2	spruce hybrid
	spruce hybrid	C	unifoliate-leaved foamflower
	Rocky Mountain Douglas-fir		
	lodgepole pine		
B_1	Sitka mountain alder		
	alpine fir		
B_2	Sitka mountain alder		
	twinberry honeysuckle		
	black swamp gooseberry		
	western thimbleberry		
	Sitka mountain-ash		
	birch-leaved spirea		
	alpine fir		
C	red baneberry		
	asters		
	blue-bead clintonia		
	Canadian bunchberry		
	western fescue		
	wild strawberry		
	mountain sweetcicely		
	one-sided wintergreen		
	dwarf red blackberry		
	false Solomon's-seal		
	simple-stemmed twisted stalk		
	western meadow-rue		
	evergreen yellow violet		
	sweet-scented bedstraw		
	large-leaved rattlesnake orchid		
D	Dicranum fuscescens		
	Ptilium crista-castrensis		

Table C.3

Cornus-moss Community Type, Alnus Variant

in the Engelmann Spruce - Subalpine Fir Zone

ALWAYS PRESENT		IMPORTANT ASSOCIATES	
Layer	Species	Layer	Species
A_2	lodgepole pine	A_1	lodgepole pine
B_1	alpine fir	A_2	alpine fir spruce hybrid Rocky Mountain Douglas-fir
B_2	alpine fir	B_1	Sitka mountain alder spruce hybrid
C	sweet-scented bedstraw large-leaved rattlesnake orchid mountain sweetcicely one-sided wintergreen	B_2	Sitka mountain alder spruce hybrid Sitka mountain-ash birch-leaved spirea
D	alpine fir seedlings		

Table C.4

Lonicera-Cornus Community Type, Equisetum Variant

in the Engelmann Spruce - Subalpine Fir Zone

ALWAYS PRESENT		IMPORTANT ASSOCIATES	
Layer	Species	Layer	Species
A_1	spruce hybrid	B_1	spruce hybrid
A_2	alpine fir	B_2	Sitka mountain alder
	spruce hybrid		Sitka moutain-ash
	Rocky Mountain Douglas-fir	C	blue-bead clintonia
B_1	alpine fir		oak fern
	Sitka mountain alder		common cow-parsnip
	black swamp gooseberry		fringed grass-of-parnassus
	birch-leaved spirea		little-flowered buttercup
B_2	alpine fir		arrow-leaved ragwort
C	red baneberry		cucumberroot twistedstalk
	asters		green false hellebore
	Columbia brome grass		
	Canadian bunchberry		
	marsh horsetail		
	western fescue		
	wild strawberry		
	northern twinflower		
	five-stamened mitrewort		
	one-flowered wintergreen		
	mountain sweetcicely		
	Arctic colt's-foot		
	lesser pyrola		
	one-sided wintergreen		
	dwarf red blackberry		
	western meadow-rue		
	unifoliate-leaved foamflower		
	spike trisetum		
	evergreen yellow violet		
	false Solomon's-seal		

Table C.5

Abies - Shrub Community Type, Pyrola Variant
in the Engelmann Spruce - Subalpine Fir Zone

ALWAYS PRESENT		IMPORTANT ASSOCIATES	
Layer	Species	Layer	Species
B_1	alpine fir	A_1	spruce hybrid
B_2	alpine fir	A_2	alpine fir spruce hybrid
C	green pyrola false Solomon's-seal	B_1	spruce hybrid
		B_2	high bush cranberry alpine fir seedlings
		C	racemose pussytoes Columbia brome grass common mitrewort five-stamened mitrewort Arctic colt's-foot unifoliate-leaved foamflower
		D	Rhytidiadelphus triquetrus

Table C.6

Pinus - *Lupinus* Community Type, Moss Variant
in the Engelmann Spruce - Subalpine Fir Zone

ALWAYS PRESENT		IMPORTANT ASSOCIATES	
Layer	Species	Layer	Species
A_2	lodgepole pine	A_1	Rocky Mountain Douglas-fir
B_1	alpine fir	B_1	spruce hybrid
			lodgepole pine
B_2	alpine-fir		Rocky Mountain Douglas-fir
C	fireweed	B_2	twinberry honeysuckle
	white hawkweed		spruce hybrid
	sickle-top lousewort		lodgepole pine
	Columbia lily		
	Arctic lupine	C	yarrow
			field pussytoes
D	*Brachythecium albicans*		racemose pussytoes
			pine grass
			common red Indian paintbrush
		D	*Dicranum fuscescens*
			Dicranum scoparium
			Ptilium crista-castrensis

Table C.7

Abies-Shrub Community Type, Clintonia Variant

in the Engelmann Spruce - Subalpine Fir Zone

ALWAYS PRESENT		IMPORTANT ASSOCIATES	
Layer	Species	Layer	Species
A_2	alpine fir spruce hybrid Rocky Mountain Douglas-fir	A_1	lodgepole pine
B_1	alpine-fir	B_1	spruce hybrid Sitka mountain alder
B_2	alpine fir	C	blue-bead clintonia sickle-top lousewort

Table C.8

Pseudotsuga - *Dicranum* Community Type, *Alnus* Variant
in the Interior Douglas-fir Zone

ALWAYS PRESENT		IMPORTANT ASSOCIATES	
Layer	Species	Layer	Species
A_1	Rocky Mountain Douglas-fir	B_2	twinberry honeysuckle
A_2	lodgepole pine		spruce hybrid
B_1	Rocky Mountain Douglas-fir		western thimbleberry
	spruce hybrid	C	green pyrola
B_2	common saskatoon		false Solomon's-seal
	Rocky Mountain Douglas-fir		
	bristly Nootka rose		
	Scouler's willow		
	birch-leaved spirea		
C	showy aster		
	northwestern sedge		
	common red Indian paintbrush		
	large-leaved rattlesnake orchid		
	northern twinflower		
	pine grass		
	fireweed		
	Arctic lupine		
	sickle-top lousewort		
	wild strawberry		
D.	*Dicranum scoparium*		

Table C.9

Pinus-Hieracium Community Type, *Rosa* Variant

in the Interior Douglas-fir Zone

ALWAYS PRESENT		IMPORTANT ASSOCIATES	
Layer	Species	Layer	Species
A_2	spruce hybrid	B_2	Sitka mountain alder
	Rocky Mountain Douglas-fir		Sitka mountain-ash
	lodgepole pine		high bush cranberry
			spruce seedlings
B_1	spruce hybrid		
		C	common western pipsissewa
B_2	common saskatoon		blue-bead clintonia
	twinberry honeysuckle		fuzzy-spiked wild rye grass
	spruce hybrid		ground-cedar
	lodgepole pine		spike trisetum
	bristly Nootka rose		
	soopolallie	D	*Brachythecium albicans*
	birch-leaved spirea		
C	yarrow		
	field pussytoes		
	showy aster		
	pine grass		
	northwestern sedge		
	fireweed		
	wild strawberry		
	northern twinflower		
	Arctic lupine		
	green pyrola		
	false Solomon's-seal		
	large-leaved rattlesnake orchid		
	white hawkweed		

Table C.10

Pinus - Hieracium Community Type, *Lonicera* Variant

in the Interior Douglas-fir Zone

ALWAYS PRESENT		IMPORTANT ASSOCIATES	
Layer	Species	Layer	Species
A_2	lodgepole pine	B_1	spruce hybrid
B_1	Rocky Mountain Douglas-fir	B_2	alpine fir
B_2	twinberry honeysuckle black swamp gooseberry western thimbleberry birch-leaved spirea high bush cranberry	C	bluejoint small reed grass Arctic colt's-foot unifoliate-leaved foamflower
C	asters Canadian bunchberry western fescue wild strawberry sweet-scented bedstraw white hawkweed northern twinflower one-sided wintergreen green pyrola dwarf red blackberry false Solomon's-seal western meadow-rue large-leaved rattlesnake orchid	D	*Dicranum fuscescens* *Ptilium crista-castrensis*
D.	*Dicranum scoparium*		

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